CHAPTER 6

CHAPTER OUTLINE

1 Types of Learning

2 Classical Conditioning

3 Operant Conditioning

4 Observational Learning

5 Cognitive Factors in Learning

6 Biological, Cultural, and Psychological Factors in Learning

7 Learning and Health and Wellness

Learning

Service Dogs Helping Heroes Heal

Returning home after serving in combat can be stressful and lonely for many military veterans. Civilian life may include coping with the wounds of war: physical injury and psychological trauma. Across the United States, nonprofit groups have paired returning military veterans with rescue dogs trained to help them make the transition from military to civilian life. Some dogs provide the simple comfort of a loving pet and help with many tasks of daily living. For example, Healing4Heroes in Atlanta provides dogs that have been through five days of training to live with U.S. military veterans as companion animals (Johnson, 2018). Another service, Pups4Patriots, trains rescued dogs as service animals, especially to assist former military members who suffer from post-traumatic stress disorder (a trauma-related psychological disorder) and traumatic brain injury (Carrozza, 2018). Canine Companions for Independence trains dogs to assist their owners by fetching medications, helping with household tasks, and so forth (Rogers, 2018). All of these services bring together people who need help and dogs who need homes. These services also rely on training that turns rescue dogs into trained professionals.

The hundreds of thousands of service dogs working in the United States are trained to aid people with a variety of disabilities. Their skills are amazing. They provide sound discrimination for the hearing impaired, assist those with limited mobility, and retrieve items that are out of reach; they locate people, bathrooms, elevators, and lost cell phones. They open and close doors, help people dress and undress, flush toilets, and even put clothes in a washer and dryer.

Truly, service dogs are highly skilled professionals. Service dogs are trained to perform these complex acts using the principles that psychologists have uncovered in studying the processes that underlie learning, the focus of this chapter. ●

PREVIEW

This chapter begins by defining learning and sketching out its main types: associative learning and observational learning. We then turn our attention to two types of associative learning—classical conditioning and operant conditioning—followed by a close look at observational learning. Next, we consider the role of cognitive processes in learning before examining biological, cultural, and psychological constraints on learning. The close of the chapter looks at the role of learning in human health and wellness.

1. TYPES OF LEARNING

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Learning anything new involves change. Once you learn the alphabet, it does not leave you; it becomes part of a "new you" who has been changed through the process of learning. Similarly, once you learn how to drive a car, you do not have to go through the process again at a later time. When you first arrived on campus at your school, you might have spent a lot of time lost. But once you got the lay of the land, you were able to navigate just fine. And perhaps you avoid eating a particular food because you once ate it and it made you sick.

By way of experience, too, you may have learned that you need to study to do well on a test, that there usually is an opening act at a rock concert, and that there is a technique to playing a guitar chord. Putting these pieces together, we arrive at a definition of **learning**: a systematic, relatively permanent change in behavior that occurs through experience.

● **learning** A systematic, relatively permanent change in behavior that occurs through experience.

If someone were to ask you what you learned in class today, you might mention new ideas you heard about, lists you memorized, or concepts you mastered. However, how would you define learning if without referring to unobservable mental processes? You might follow the lead of behavioral psychologists. **Behaviorism** is a theory of learning that focuses solely on observable behaviors, discounting the importance of mental activity such as thinking, wishing, and hoping. Psychologists who examine learning from a behavioral perspective define learning as relatively stable, observable changes in behavior. The behavioral approach emphasizes general laws that guide behavior change and make sense of some puzzling aspects of human life (Greenwood, 2015).

● **behaviorism** A theory of learning that focuses solely on observable behaviors, discounting the importance of mental activity such as thinking, wishing, and hoping.

Behaviorism maintains that the principles of learning are the same whether we are talking about humans or nonhuman animals. Because of the influence of behaviorism, psychologists' understanding of learning started with studies of rats, cats, pigeons, and even raccoons. A century of research on learning in animals and in humans suggests that many of the principles generated initially in research on animals also apply to humans.

In this chapter we look at two types of learning: associative learning and observational learning. Let's briefly review each of these before getting into the details.

First, **associative learning** occurs when an organism makes a connection, or an association, between two events. *Conditioning* is the process of learning these associations. There are two types of conditioning–classical and operant–both of which have been studied by behaviorists.

● **associative learning** Learning that occurs when an organism makes a connection, or an association, between two events.

In *classical conditioning,* organisms learn the association between two stimuli. As a result of this association, organisms learn to anticipate events. For example, lightning is associated with thunder and regularly precedes it. Thus, when we see lightning, we anticipate that we will hear thunder soon afterward. In *operant conditioning,* organisms learn the association between a behavior and a consequence, such as a reward. As a result of this association, organisms learn to increase behaviors that are followed by rewards and to decrease behaviors that are followed by punishment. For example, children are likely to repeat their good manners if their parents reward them with candy after they have shown good manners. Also, if children's bad manners provoke scolding words and harsh glances by parents, the children are less likely to repeat the bad manners. Figure 1 compares classical and operant conditioning.

Much of what we learn, however, is not a result of direct consequences but rather of exposure to models performing a behavior or skill (Ma & others, 2018; Schoppmann,

FIGURE 1 **Associative Learning: Comparing Classical and Operant Conditioning** (*first*) In this example of classical conditioning, a child associates a doctor's office (stimulus 1) with getting a painful injection (stimulus 2). (*second*) In this example of operant conditioning, performing well in a swimming competition (behavior) becomes associated with getting awards (consequences).
(first) ©Punchstock; (second) ©Philip Nealey/Getty Images; (third) ©Ryan McVay/Getty Images; (fourth) ©kali9/Getty Images

Schneider, & Seehagen, 2018). For instance, as you watch someone shoot baskets, you get a sense of how the shots are made. This brings us to our second type of learning: observational learning. **Observational learning** occurs when a person observes and imitates another's behavior. Observational learning is different from the associative learning described by behaviorism because it relies on mental processes: The learner has to pay attention, remember, and reproduce what the model did (Howard, Festa, & Lonsdorf, 2018). Observational learning is especially important to human beings. In fact, watching other people is another way in which human infants acquire skills.

● **observational learning** Learning that involves observing and imitating another's behavior.

Human infants differ from baby monkeys in their strong reliance on imitation (Gerson, Simpson, & Paukner, 2016). After watching an adult model perform a task, a baby monkey will figure out its own way to do it, but a human infant will do exactly what the model did. Imitation may be the human baby's way to solve the huge problem it faces: to learn the vast amount of cultural knowledge that is part of human life. Many of our behaviors are rather arbitrary. Why do we clap to show approval or wave hello or bye-bye? The human infant has a lot to learn and may be well served to follow the old adage, "When in Rome, do as the Romans do."

Learning applies to many areas of acquiring new behaviors, skills, and knowledge. Our focus in this chapter is on the two types of associative learning—classical conditioning and operant conditioning—and on observational learning. Interestingly, the human capacity to learn has inspired computer scientists and engineers who work in the area of *artificial intelligence*. As we will see in the chapter "Thinking, Intelligence, and Language", artificial intelligence involves creating machines capable of performing activities that require intelligence when people do them. *Machine learning* is a branch of artificial intelligence that focuses on creating machines that can change their behavior in response to data without a human being stepping in. Do machines actually learn? To explore this provocative question, see the Critical Controversy.

test yourself

1. What is associative learning?
2. What is conditioning? What two types of conditioning have behavioral psychologists studied?
3. What is observational learning? Give two examples of it.

2. CLASSICAL CONDITIONING

Early one morning, Bob is in the shower. While he showers, his wife enters the bathroom and flushes the toilet. Scalding hot water suddenly bursts down on Bob, causing him to yell in pain. The next day, Bob is back for his morning shower, and once again his wife enters the bathroom and flushes the toilet. Panicked by the sound of the toilet flushing, Bob yelps in fear and jumps out of the shower stream. Bob's panic at the sound of the toilet flushing illustrates the learning process of **classical conditioning**, in which a neutral stimulus (the sound of a toilet flushing) becomes associated with an innately meaningful stimulus (the pain of scalding hot water) and acquires the capacity to elicit a similar response (panic).

● **classical conditioning** Learning process in which a neutral stimulus becomes associated with an innately meaningful stimulus and acquires the capacity to elicit a similar response.

CRITICAL CONTROVERSY

Can Machines Truly *Learn?*

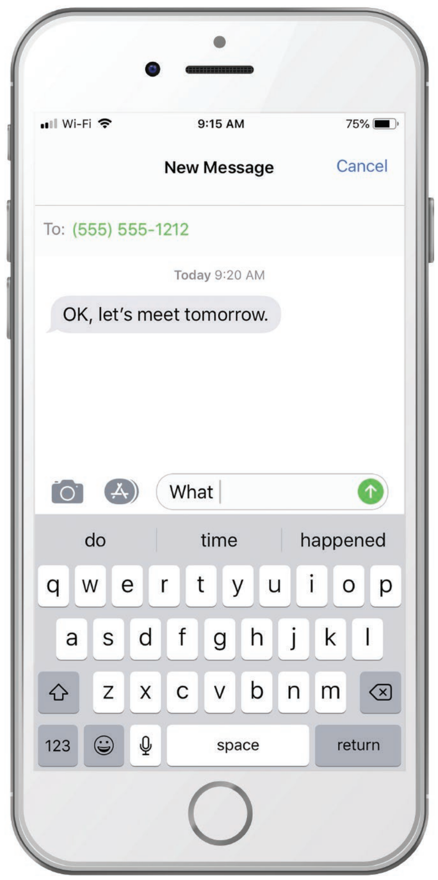
Entering a word in a text box on a smartphone, you have likely noticed the predictive text that appears just above the keyboard, offering suggestions to finish your sentence. You type in “what” and it suggests, “time” or “happened.” This is just one example of machine learning, that branch of artificial intelligence in which computers use data to reach conclusions, make decisions, offer suggestions, and so forth. That predictive text is a result of a machine learning about human language and your typical texting behavior. Machine learning occurs when a computer program is able to use data to direct its own actions without the intervention of a human programmer. The first example of machine learning was a program for a checkers game that learned from its successes and failures, invented by Arthur Samuel in 1959. Today across a wide range of contexts, computer scientists “train” computers to rely on ever expanding databases to direct their actions.

The question is, are computers actually *learning*? As you consider this question you might recognize that the answer depends very much on what is meant by *actually learning* (Burgos, 2018). Let’s consider the definition offered in the main text above: “a systematic, relatively permanent change in behavior that occurs through experience.” Nowhere in this definition does the word “living organism” appear. Does that mean that nonliving entities, such as computers, can learn?

Let’s apply our definition to an example of machine learning, an email spam filter. Spam emails are unsolicited messages often involving sales or even fraud. For example, someone tells you that they will deposit $1 million into your bank account if you give them your account information. You have likely had an email appear in your inbox with the warning “SUSPECTED SPAM.” This warning is the product of machine learning. The spam filter relies on a huge database of all words and phrases that might reveal whether a message is likely being sent with malicious intent. The program searches all incoming messages for these indicators, calculating the probability that any given message is spam. The program monitors its own success or failure in identifying spam and then tinkers with the database—perhaps adding a phrase or deleting another. Over time, it becomes more and more precise at detecting spam emails. Has that program then, *learned*? What separates what it has done from what a dog, a cat, or human has done when learning occurs?

In computer science, *deep learning* refers to modeling computer programs after the human brain, sensory processes, and behavior. We might ask, If computers simply model human behavior, can we say they are *really* learning (Burgos, 2018)? Consider that when this type of program starts processing, it starts changing itself and its behavior based on experience.

Media depictions of artificial intelligence often imply that humans will be in grave danger if intelligent machines begin to think for themselves. Are we all at risk of being enslaved by robot overlords? Probably not, but the feeling that machines might replace us may explain our reluctance to call their relatively permanent change in behavior based on experience true learning. If a computer program alters its own behavior based on experience, might that be considered learning?



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WHAT DO YOU THINK?

- Other than predictive text and spam filters, what is one example of machine learning you have encountered in your daily life?
- Do you think computers truly *learn*? Why or why not?

Pavlov’s Studies

Even before beginning this course, you might have heard about Pavlov’s dogs. The work of the Russian physiologist Ivan Pavlov is well known. Still, it is easy to take its true significance for granted. Importantly, Pavlov demonstrated that neutral aspects of the environment can attain the capacity to evoke responses through pairing with other stimuli and that bodily processes can be influenced by environmental cues.

In the early 1900s, Pavlov was interested in how the body digests food. In his experiments, he routinely placed meat powder in a dog's mouth, causing the dog to salivate. By accident, Pavlov noticed that the meat powder was not the only stimulus that caused the dog to drool. The dog salivated in response to a number of stimuli associated with the food, such as the sight of the food dish, the sight of the individual who brought the food into the room, and the sound of the door closing when the food arrived. Pavlov recognized that the dog's association of these sights and sounds with the food was an important type of learning, which came to be called *classical conditioning.*

Pavlov wanted to know *why* the dog salivated in reaction to various sights and sounds before eating the meat powder. He observed that the dog's behavior included both unlearned and learned components. The unlearned part of classical conditioning is based on the fact that some stimuli automatically produce responses apart from any prior learning; in other words, they are inborn (innate). *Reflexes* are such automatic stimulus-response connections. They include salivation in response to food, nausea in response to spoiled food, shivering in response to low temperature, coughing in response to throat congestion, pupil constriction in response to light, and withdrawal in response to pain.

An **unconditioned stimulus (US)** is a stimulus that produces a response without prior learning; food was the US in Pavlov's experiments. An **unconditioned response (UR)** is an unlearned reaction that is automatically elicited by the US. Unconditioned responses are involuntary; they happen in response to a stimulus without conscious effort. In Pavlov's experiment, drooling in response to food was the UR. In the case of Bob and the flushing toilet, Bob's learning and experience did not cause him to shriek when the hot water hit his body. His cry of pain occurred automatically. The hot water was the US, and Bob's panic was the UR.

● **unconditioned stimulus (US)** A stimulus that produces a response without prior learning.

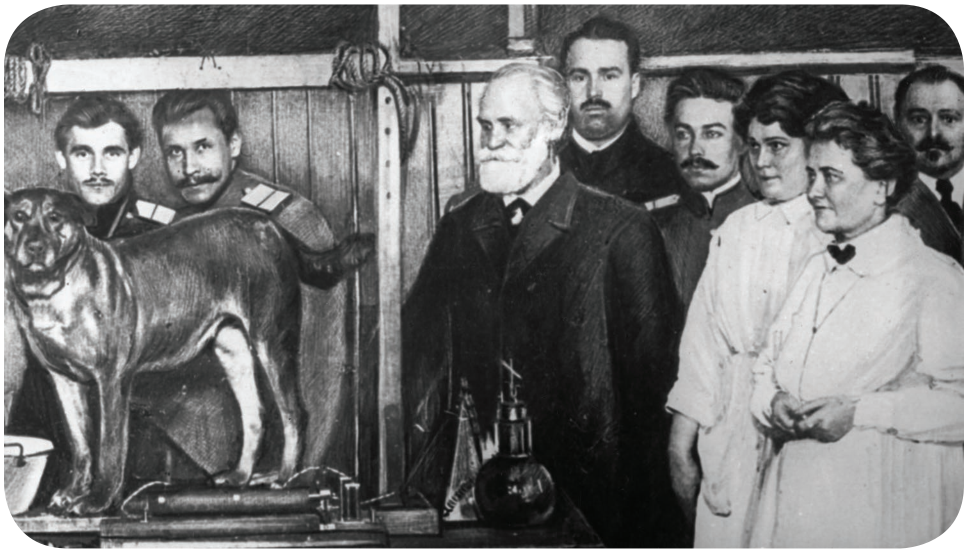
● **unconditioned response (UR)** An unlearned reaction that is automatically elicited by the unconditioned stimulus.

In classical conditioning, a **conditioned stimulus (CS)** is a previously neutral stimulus that eventually elicits a conditioned response after being paired with the unconditioned stimulus. The **conditioned response (CR)** is the learned response to the conditioned stimulus that occurs after CS–US pairing (Pavlov, 1927). Sometimes conditioned responses are quite similar to unconditioned responses, but typically they are not as strong.

● **conditioned stimulus (CS)** A previously neutral stimulus that eventually elicits a conditioned response after being paired with the unconditioned stimulus.

● **conditioned response (CR)** The learned response to the conditioned stimulus that occurs after conditioned stimulus–unconditioned stimulus pairing.

In studying a dog's response to various stimuli associated with meat powder, Pavlov rang a bell before giving meat powder to the dog. Until then, ringing the bell did not have an effect on the dog, except perhaps to wake the dog from a nap. The bell was a *neutral* stimulus, meaning that in the dog's world, this stimulus did not have any signal value at all. Prior to being paired with the meat powder, the bell was meaningless. However, the dog began to associate the sound of the bell with the food and salivated when it heard



Pavlov (the white-bearded gentleman in the center) is shown demonstrating the nature of classical conditioning to students at the Military Medical Academy in Russia.

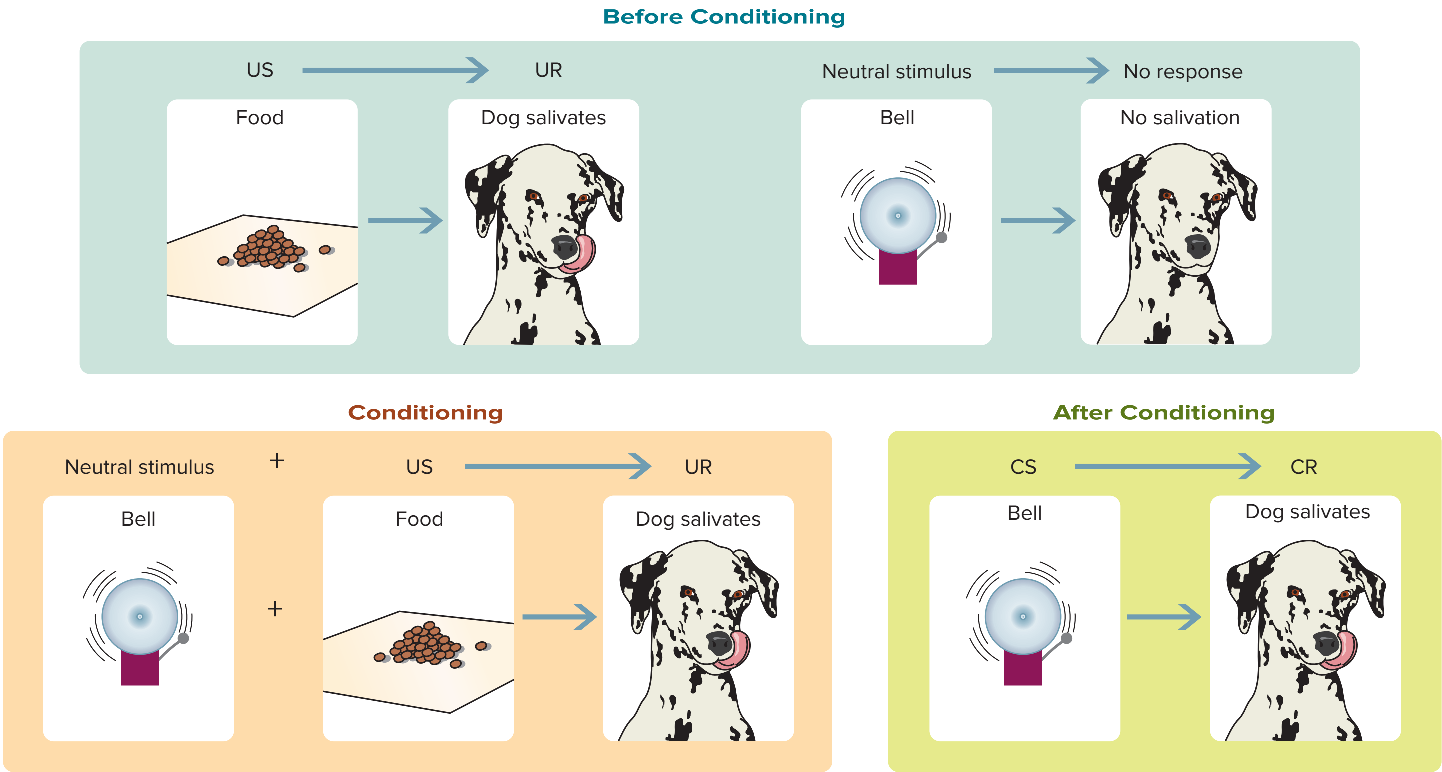


FIGURE 2 **Pavlov's Classical Conditioning** In one experiment, Pavlov presented a neutral stimulus (bell) just before an unconditioned stimulus (food). The neutral stimulus became a conditioned stimulus by being paired with the unconditioned stimulus. Subsequently, the conditioned stimulus (bell) by itself was able to elicit the dog's salivation.

the bell. The bell had become a conditioned (learned) stimulus (CS), and salivation was now a conditioned response (CR). In the case of Bob's interrupted shower, the sound of the toilet flushing was the CS, and panicking was the CR after the scalding water (US) and the flushing sound (CS) were paired. Figure 2 summarizes how classical conditioning works.

Researchers have shown that salivation can be used as a conditioned response not only in dogs and humans but also in, of all things, cockroaches (Nishino & others, 2015; Watanabe & Mizunami, 2007). These researchers paired the smell of peppermint (the CS, which was applied to the cockroaches' antennae) with sugary water (the US). Cockroaches naturally salivate (the UR) in response to sugary foods, and after repeated pairings between peppermint smell and sugary water, the cockroaches salivated in response to the smell of peppermint (the CR). When they collected and measured the cockroach saliva, the researchers found that the cockroaches had slobbered over that smell for 2 minutes.

To summarize, in classical conditioning, two stimuli are paired repeatedly. The US is the one that evokes an automatic response—including things like food or loud noises. The UR is that automatic response. The CS comes before the US and this stimulus would not evoke a natural response except that it is being paired with the US. The response to the CS is the CR. Classical conditioning involves learning because the organism responds to the CS in a new way, because of the learned association between the CS and the US.

ACQUISITION

● **acquisition** The initial learning of the connection between the unconditioned stimulus and the conditioned stimulus when these two stimuli are paired.

Whether it is human beings, dogs, or cockroaches, the first part of classical conditioning is called acquisition. **Acquisition** is the initial learning of the connection between the US and CS when these two stimuli are paired (as with a bell and food). During acquisition, the CS is repeatedly presented followed by the US. Eventually, the CS will produce a response. Note that classical conditioning is a type of learning that occurs without awareness or effort, based on the presentation of two stimuli together. For this pairing to work, however, two important factors must be present: contiguity and contingency.

Contiguity means that the CS and US are presented very close together in time—even a mere fraction of a second apart. In Pavlov's work, if the bell had rung 20 minutes before the presentation of the food, the dog probably would not have associated the bell with the food because the bell would not have served as a *timely* signal that food was coming.

Pairing the CS and US close together in time is not all that is needed for conditioning to occur. Imagine that the bell not only rings just before the food is delivered, but it also rings many times when the food is not on its way. In such a situation, the dog would not associate the bell with the food, and no learning would occur. Why? Because the CS is not a signal that the US is coming. *Contingency* means that the CS must serve as a reliable indicator that the US is on its way (Rescorla, 1966, 1988, 2009).

To get a sense of the importance of contingency, imagine that the dog in Pavlov's experiment is exposed to a ringing bell at random times all day long. Whenever the dog receives food, the delivery of the food always immediately follows a bell ring. However, in this situation, the dog will not associate the bell with the food, because the bell is not a reliable signal that food is coming: It rings a lot when no food is on the way. Whereas *contiguity* refers to the fact that the CS and US occur close together in time, *contingency* refers to the information value of the CS relative to the US. When contingency is present, the CS provides a systematic signal that the US is on its way (Kringelbach & Berridge, 2015).

GENERALIZATION AND DISCRIMINATION

Pavlov found that the dog salivated in response not only to the tone of the bell but also to other sounds, such as a whistle. These sounds had not been paired with the unconditioned stimulus of the food. Pavlov discovered that the more similar the noise was to the original sound of the bell, the stronger the dog's salivary flow.

Generalization in classical conditioning is the tendency of a new stimulus that is similar to the original conditioned stimulus to elicit a response that is similar to the conditioned response.

● **generalization (in classical conditioning)** The tendency of a new stimulus that is similar to the original conditioned stimulus to elicit a response that is similar to the conditioned response.

Generalization has value in preventing learning from being tied to specific stimuli. Once we learn the association between a given CS (say, flashing police lights behind our car) and a particular US (the dread associated with being pulled over), we do not have to learn it all over again when a similar stimulus presents itself (a police car with its siren howling as it cruises directly behind our car).

Stimulus generalization is not always beneficial. For example, the cat that generalizes from a harmless minnow to a dangerous piranha has a major problem; therefore, it is important to also discriminate among stimuli. **Discrimination** in classical conditioning is the process of learning to respond to certain stimuli and not others. To produce discrimination, Pavlov gave food to the dog only after ringing the bell and not after any other sounds. In this way, the dog learned to distinguish between the bell and other sounds.

● **discrimination (in classical conditioning)** The process of learning to respond to certain stimuli and not others.

EXTINCTION AND SPONTANEOUS RECOVERY

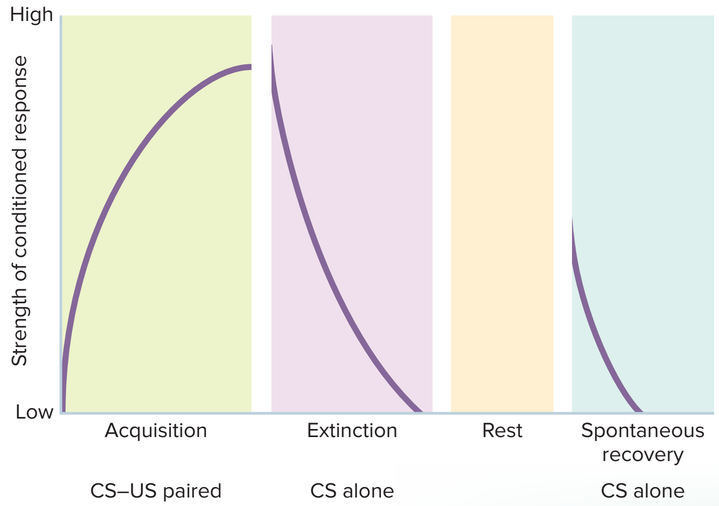
After conditioning the dog to salivate at the sound of a bell, Pavlov rang the bell repeatedly in a single session and did not give the dog any food. Eventually the dog stopped salivating. This result is **extinction**, which in classical conditioning is the weakening of the conditioned response when the unconditioned stimulus is absent. Without continued association with the unconditioned stimulus (US), the conditioned stimulus (CS) loses its power to produce the conditioned response (CR). You might notice that although extinction weakens the link between the CS and the presence of the US, it can also be thought of as a second type of learning: learning that the CS means the US is *not* coming.

● **extinction (in classical conditioning)** The weakening of the conditioned response when the unconditioned stimulus is absent.

Extinction is not always the end of a conditioned response. The day after Pavlov extinguished the conditioned salivation to the sound of a bell, he took the dog to the laboratory and rang the bell but still did not give the dog any meat powder. The dog salivated, indicating that an extinguished response can spontaneously recur. **Spontaneous recovery** is the process in classical conditioning by which a conditioned response can recur after a time delay, without further conditioning (Monaco & others, 2018; Thompson, McEvoy, & Lipp, 2018).

● **spontaneous recovery** The process in classical conditioning by which a conditioned response can recur after a time delay, without further conditioning.

psychological *inquiry*



From Acquisition to Extinction (to Spontaneous Recovery)

The figure illustrates the strength of a conditioned response (CR), shown on the Y or vertical axis, across the stages from acquisition, to extinction, to a rest period, and finally to spontaneous recovery. Using the graphs, answer the following questions.

1. What happens to the unconditioned stimulus (US) and the conditioned stimulus (CS) during acquisition, and how does this influence the conditioned response (CR)?
2. When is the CR strongest and when is it weakest?
3. What happens to the US and CS during extinction, and how does this influence the CR?
4. Notice that spontaneous recovery occurs after a rest period. Why is this rest necessary?
5. In your own life, what are some conditioned stimuli that are attached to conditioned responses for you? Trace them through these steps.

Consider an example of spontaneous recovery you may have experienced: You thought that you had forgotten about (extinguished) an old girlfriend or boyfriend, but then you found yourself in a particular context (perhaps the restaurant where you used to dine together), and you suddenly got a mental image of your ex, accompanied by an emotional reaction to him or her from the past (spontaneous recovery).

The steps in classical conditioning are reviewed in the Psychological Inquiry. The figure in the feature shows the sequence of acquisition, extinction, and spontaneous recovery. Spontaneous recovery can occur several times, but as long as the conditioned stimulus is presented alone (that is, without the unconditioned stimulus), spontaneous recovery becomes weaker and eventually ceases.

● **renewal** The recovery of the conditioned response when the organism is placed in a novel context.

Not only do extinguished learned associations show spontaneous recovery, but they can be reinstated just by moving the organism to a new setting. **Renewal** refers to the recovery of the conditioned response when the organism is placed in a novel context (Anderson & Petrovich, 2018). Renewal can be a powerful problem to overcome—as it is when a person leaves a drug treatment facility to return to his or her previous living situation (Marchant & others, 2018).

The processes of acquisition, extinction, spontaneous recovery, and renewal all demonstrate the important role of learned associations for the survival of all creatures. All animals, including humans, are, in some ways, on the look-out for survival-relevant connections, such as learning what cues signal food. Once such connections are made, they are difficult to break entirely as demonstrated in spontaneous recovery. Finally, those connections remain in the organism's repertoire and can pop back up in a new setting.

Classical Conditioning in Humans

Although the process of classical conditioning has often been studied in nonhuman animals, the human capacity to learn associations is extremely important for our survival. Here we review examples of classical conditioning at work in human life.

EXPLAINING FEARS

Classical conditioning provides an explanation of fears. John B. Watson (who coined the term *behaviorism*) and Rosalie Rayner (1920) demonstrated classical conditioning's role in the development of fears with an infant named Albert. They showed Albert a white laboratory rat to see whether he was afraid of it. He was not. As Albert played with the rat, the researchers sounded a loud noise behind his head. The noise caused little Albert to cry. After only seven pairings of the loud noise with the white rat, Albert began to fear the rat even when the noise was not sounded. Albert's fear was generalized to a rabbit, a dog, and a sealskin coat.

Let's use Albert's example to review the key concepts of classical conditioning. In the beginning, Albert had no response to the rat. The rat, then, is a neutral stimulus—the conditioned stimulus (or CS). The rat was then paired with a loud noise. The loud noise would startle Albert and make him cry: Loud noises upset babies. That makes the loud noise the unconditioned stimulus (US), because it evokes a response naturally without the need for learning. Albert's reaction to the loud noise is the unconditioned response (or UR). Again, being upset by loud noises is something that babies just do. The white rat (CS) and loud noise (US) were paired together in time, and each time the loud noise would upset little Albert (UR). This pairing is the process of acquisition. Then, the rat (the CS) was presented to Albert without the loud noise (the US), and Albert became alarmed and afraid even without the noise. Poor Albert's enduring fear of the rat is the conditioned response (CR).

Today, Watson and Rayner's (1920) study would violate the ethical guidelines of the American Psychological Association. In any case, Watson correctly concluded that we learn many of our fears through classical conditioning. We might develop fear of the dentist because of a painful experience, fear of driving after having been in a car crash, and fear of dogs after having been bitten by one.

If we can learn fears through classical conditioning, we also can possibly unlearn them through that process. In the chapter "Therapies", for example, we will examine the application of classical conditioning to therapies for treating phobias.

Watson and Rayner conditioned 11-month-old Albert to fear a white rat by pairing the rat with a loud noise. When little Albert was later presented with other stimuli similar to the white rat, such as the rabbit shown here with Albert, he was afraid of them too. This study illustrates stimulus generalization in classical conditioning.

Courtesy of Professor Benjamin Harris

BREAKING HABITS

Counterconditioning is a classical conditioning procedure for changing the relationship between a conditioned stimulus and its conditioned response. Therapists have used counterconditioning to break apart the association between certain stimuli and positive feelings (Kang & others, 2018). **Aversive conditioning** is a form of treatment that consists of repeated pairings of a stimulus with a very unpleasant stimulus. Electric shocks, loud noises, and nausea-inducing substances are examples of noxious stimuli that are used in aversive conditioning.

- **counterconditioning** A classical conditioning procedure for changing the relationship between a conditioned stimulus and its conditioned response.
- **aversive conditioning** A form of treatment that consists of repeated pairings of a stimulus with a very unpleasant stimulus.

To reduce drinking, for example, every time a person drinks an alcoholic beverage, he or she also consumes a mixture that induces nausea. In classical conditioning terminology, the alcoholic beverage is the conditioned stimulus, and the nausea-inducing agent is the unconditioned stimulus. Through a repeated pairing of alcohol with the nausea-inducing agent, alcohol becomes the conditioned stimulus that elicits nausea, the conditioned response. As a consequence, alcohol no longer is associated with something pleasant but rather with something highly unpleasant. The effectiveness of Antabuse, a drug that has been used in treating alcoholism since the late 1940s, is based on this association (Ullman, 1952; Williams & others, 2018). When someone takes this drug, ingesting even the smallest amount of alcohol will make the person quite ill, even if the exposure to the alcohol is through mouthwash or cologne. Antabuse continues to be used in treating alcoholism today.

Classical conditioning is likely to be at work whenever we engage in mindless, habitual behavior (Marien, Custers, & Aarts, 2018). Cues in the environment serve as conditioned stimuli, evoking feelings and behaviors without thought. These associations become implicit "if-then" connections: If you are sitting in front of your laptop, then you check your e-mail. These automatic associations can function for good (for instance, you get up every morning and go for a run without even thinking) or ill (you walk into the kitchen and open the fridge for a snack without even thinking).

CLASSICAL CONDITIONING AND THE PLACEBO EFFECT

The chapter "Psychology's Scientific Method" defined the *placebo effect* as the effect of a substance (such as taking a pill orally) or a procedure (such as using a syringe to inject a substance) that researchers use as a control to identify the actual effects of a treatment. Placebo effects are observable changes (such as a drop in pain) that cannot be explained by the effects of an actual treatment. The principles of classical conditioning can help to explain some of these effects (Colloca, 2019; Tu & others, 2019). In this case, the pill or syringe serves as a CS, and the actual drug is the US. After the experience of pain relief following the consumption of a drug, for instance, the pill or syringe might lead to a CR of reduced pain even in the absence of an actual painkiller. The strongest evidence for the role of classical conditioning on placebo effects comes from research on the immune system and the endocrine system.

CLASSICAL CONDITIONING AND THE IMMUNE AND ENDOCRINE SYSTEMS

Even the human body's internal organ systems can be classically conditioned. The immune system is the body's natural defense against disease. A number of studies reveal that classical conditioning can produce *immunosuppression,* a decrease in the production of antibodies, which can lower a person's ability to fight disease (Tekampe & others, 2018).

The initial discovery of this link between classical conditioning and immunosuppression came as a surprise. In studying classical conditioning, Robert Ader (1974) was examining how long a conditioned response would last in some laboratory rats. He paired a conditioned stimulus (saccharin solution) with an unconditioned stimulus, a drug called Cytoxan, which induces nausea. Afterward, while giving the rats saccharin-laced water without the accompanying Cytoxan, Ader watched to see how long it would take the rats to forget the association between the two.

Unexpectedly, in the second month of the study, the rats developed a disease and began to die off. In analyzing this unforeseen result, Ader looked into the properties of the nausea-inducing drug he had used. He discovered that one of its side effects was suppressed immune system functioning. It turned out that the rats had been classically conditioned to associate sweet water not only with nausea but also with the shutdown of the immune system. The sweet water apparently had become a conditioned stimulus for immunosuppression.

Researchers have found that conditioned immune responses also occur in humans (Hadamitzky & others, 2018; Tekampe & others, 2018). For example, consider that individuals who receive donated organs must begin a lifetime of immunosuppressing medication. These medicines help to prevent the body from rejecting the donated organ. Could classical conditioning allow individuals to reduce reliance on these medications? A recent study showed that it is possible to use classical conditioning to reduce the immune response in individuals who have received a kidney transplant (Kirchhof & others, 2018). In the study, a particular taste was paired with immunosuppressing drugs in 30 transplant patients. Results showed the taste alone did eventually lead to lowered immune response. This work suggests that classical conditioning might be leveraged to improve the lives of individuals who receive transplants, both by boosting the effectiveness of medications and by reducing dosages.

Classical conditioning effects have also been found for the endocrine system. Recall from the "Biological Foundations of Behavior" chapter that the endocrine system is a loosely organized set of glands that produce and circulate hormones. Research has shown that placebo pills can influence the secretion of hormones if patients had previous experiences with pills containing actual drugs that affected hormone secretion (Piedimonte & Benedetti, 2015). Studies have revealed that the sympathetic nervous system (the part of the autonomic nervous system that responds to stress) plays an important role in the learned associations between conditioned stimuli and immune and endocrine functioning (Tekampe & others, 2018).

TASTE AVERSION LEARNING

Consider this scenario. Mike goes out for sushi with some friends and eats spicy yellow tail, his favorite dish. He then proceeds to a jazz concert. Several hours later, he becomes very ill with stomach pains and nausea. A few weeks later, he tries to eat spicy yellow tail again but cannot stand it. Importantly, Mike does not experience an aversion to jazz, even though he attended the jazz concert that night before getting sick. Mike's experience exemplifies *taste aversion:* a special kind of classical conditioning involving the learned association between a particular taste and nausea (Garcia, Ervin, & Koelling, 1966; Lavi & others, 2018; Nakajima, 2018; Ward-Fear & others, 2017).

Taste aversion is special because it typically requires only one pairing of a neutral stimulus (a taste) with the unconditioned response of nausea to seal that connection, often for a very long time. As we consider later, it is highly adaptive to learn taste aversion in only one trial. An animal that required multiple pairings of taste with poison likely would not survive the acquisition phase. It is notable, though, that taste aversion can occur even if the "taste" had nothing to do with getting sick—perhaps, in Mike's case, he was simply coming down with a stomach bug. Taste aversion can even occur when a person has been sickened by a completely separate event, such as being spun around in a chair (Klosterhalfen & others, 2000).

Although taste aversion is often considered an exception to the rules of learning, Michael Domjan (2005, 2015) has suggested that this form of learning demonstrates how classical conditioning works in the natural world, where associations matter to survival. Remember, in taste aversion, the taste or flavor is the CS; the agent that made the person sick (it could be a roller-coaster ride or salmonella, for example) is the US; nausea or vomiting is the UR; and taste aversion is the CR.

Taste aversion learning is particularly important in the context of the traditional treatment of some cancers. Chemotherapy for cancer can produce nausea in patients, with the result that individuals sometimes develop strong aversions to foods they ingest prior to treatment (Coa & others, 2015; Davidson & Riley, 2015; Krautbauer & Drossel, 2018). Consequently, they may experience a general tendency to be turned off by food, a situation that can lead to nutritional deficits (Krautbauer & Drossel, 2018).

Researchers have used classical conditioning principles to combat these taste aversions, especially in children, for whom antinausea medication is often ineffective (Skolin & others, 2006) and for whom aversions to protein-rich food are particularly problematic (Ikeda & others, 2006). Early studies demonstrated that giving children a "scapegoat" conditioned stimulus prior to chemotherapy would help contain the taste aversion to only one specific type of food or flavor (Broberg & Bernstein, 1987). For example, children might be given a particular flavor of Life Savers® candy before receiving treatment. For these children, the nausea would be more strongly associated with the Life Savers flavor than with the foods they needed to eat for good nutrition. These results show discrimination in classical conditioning—the kids developed aversions only to the specific scapegoat flavor.

The U.S. Fish and Wildlife Service is trying out taste aversion as a tool to prevent Mexican gray wolves from preying on cattle. To instill taste aversion for beef, the agency is deploying bait made of beef and cowhide that also contains odorless and flavorless substances that induce nausea (Bryant, 2012). The hope is that wolves that are sickened by the bait will no longer prey on cattle and might even rear their pups to enjoy alternative meals.

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CLASSICAL CONDITIONING AND ADVERTISING

Classical conditioning provides the foundation for many of the commercials that bombard us daily. (Appropriately, when John Watson, whom you will recall from the baby Albert study, left the field of psychology, he went into advertising.) Think about it: Advertising involves creating an association between a product and pleasant feelings (buy that pumpkin spice latte and be happy). TV advertisers cunningly apply classical conditioning principles to consumers by showing ads that pair something positive—such as a beautiful woman (the US) producing pleasant feelings (the UR)—with a product (the CS) in hopes that you, the viewer, will experience those positive feelings toward the product (the CR).

Even when commercials are not involved, advertisers exploit classical conditioning principles—for instance, through the technique of product placement, or what is known as *embedded marketing*. For example, suppose that while viewing a TV show or movie, you notice that a character is drinking a particular brand of soft drink or eating a particular type of cereal. By placing their products in the context of a show or movie you like, advertisers are hoping that your positive feelings about the show, movie plot, or a character (the UR) rub off on their product (the CS). It may seem like a long shot, but all they need to do is enhance the chances that, say, navigating through a car dealership or a grocery store, you will feel attracted to their product.

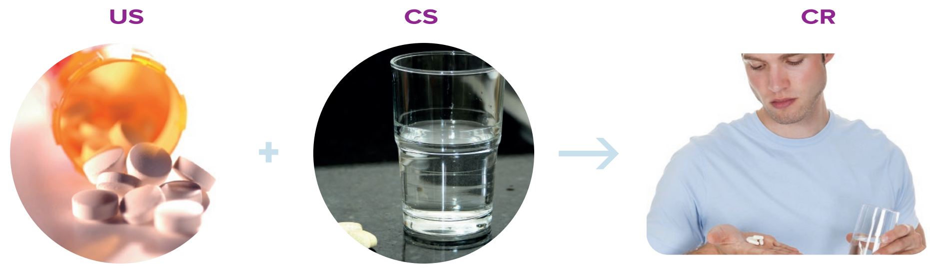


FIGURE 3 **Drug Habituation** The figure illustrates how classical conditioning is involved in drug habituation. As a result of conditioning, the drug user will need to take more of the drug to get the same effect as the person did before the conditioning. Moreover, if the user takes the drug without the usual conditioned stimulus or stimuli—represented in the middle panel by the bathroom and the drug tablets—overdosing is more likely.
(first) ©Thinkstock/Jupiterimages; (second) ©McGraw-Hill Education/Jill Braaten, photographer; (third) ©AndreyPopov/iStockphoto/Getty Images

The psychoactive drug is an unconditioned stimulus (US) because it naturally produces a response in the body.

Appearance of the drug tablets and the room where the person takes the drug are conditioned stimuli (CS) that are paired with the drug (US).

The body prepares to receive the drug in the room. Repeated pairings of the US and CS have produced a conditioned response (CR).

DRUG HABITUATION

The "States of Consciousness" chapter noted how, over time, a person might develop a tolerance for a psychoactive drug and need a higher and higher dose of the substance to get the same effect. Classical conditioning helps to explain **habituation**, which refers to the decreased responsiveness to a stimulus after repeated presentations. A mind-altering drug is an unconditioned stimulus: It naturally produces a response in the person's body. This unconditioned stimulus is often paired systematically with a previously neutral stimulus (CS). For instance, the physical appearance of the drug in a pill or syringe, and the room where the person takes the drugs, are conditioned stimuli that are paired with the unconditioned stimulus of the drug. These repeated pairings should produce a conditioned response, and they do—but it is different from those we have considered so far.

● **habituation** Decreased responsiveness to a stimulus after repeated presentations.

The conditioned response to a drug can be the body's way of *preparing* for the effects of a drug (Junior & others, 2018; Ettenberg & others, 2015). In this case, the body braces itself for the effects of the drug with a CR that is the opposite of the UR. For instance, if the drug (the US) leads to an increase in heart rate (the UR), the CR might be a drop in heart rate. The CS serves as a warning that the drug is coming, and the conditioned response in this case is the body's compensation for the drug's effects (Figure 3). In this situation the conditioned response works to decrease the effects of the US, making the drug experience less intense. Some drug users try to prevent habituation by varying the physical location where they take the drug.

This aspect of drug use can play a role in deaths caused by drug overdoses. How is classical conditioning involved? A user typically takes a drug in a particular setting, such as a bathroom, and acquires a CR to this location (McClernon & others, 2015; Siegel, 1988). Because of classical conditioning, as soon as the drug user walks into the bathroom, the person's body begins to prepare for and anticipate the drug dose in order to lessen the effect of the drug. Essentially, the context in which the drug is taken (for example, the bathroom) becomes a CS that signals that the drug is coming. However, if the user takes the drug in a location other than the usual one, such as at a rock concert, the drug's effect is greater because no conditioned responses have built up in the new setting, and therefore the body is not prepared for the drug.

When you read about cases of deadly overdoses, note how often the person has taken the drug under unusual circumstances or after a visit to rehab. In these cases, with no CS signal, the body is unprepared for (and tragically overwhelmed by) the drug's effects. After time in rehab, the associative links have been extinguished and the individual is at risk of overdosing (Rafful & others, 2018).

test yourself

1. What is meant by an unconditioned stimulus (US) and an unconditioned response (UR)? In Pavlov's experiments with dogs, what were the US and the UR?
2. What is meant by a conditioned stimulus (CS) and a conditioned response (CR)? In Pavlov's experiments with dogs, what were the CS and the CR?
3. What learning principle is illustrated by the Watson and Rayner study with baby Albert?

3. OPERANT CONDITIONING

Recall from early in the chapter that classical conditioning and operant conditioning are forms of associative learning, which involves learning that two events are connected. In classical conditioning, organisms learn the association between two stimuli (US and CS). Classical conditioning is a form of *respondent behavior,* behavior that occurs in automatic response to a stimulus such as a nausea-producing drug and later to a conditioned stimulus such as sweet water that was paired with the drug. Calling a behavior "respondent" means that it happens on auto pilot.

Classical conditioning explains how neutral stimuli become associated with unlearned, *involuntary responses.* Classical conditioning is not as effective, however, in explaining *voluntary behaviors.* Voluntary actions, such as a student studying hard for a test, a gambler playing slot machines in Las Vegas, or a service dog fetching his owner's cell phone on command, are clearly not the product of associating a CS and US. Rather, they must be explained by a different kind of associative learning, operant conditioning. Operant conditioning is usually much better than classical conditioning at explaining such voluntary behaviors. Whereas classical conditioning focuses on the association between stimuli, operant conditioning focuses on the association between behaviors and the stimuli that follow them.

Defining Operant Conditioning

Operant conditioning or instrumental conditioning is a form of associative learning in which the consequences of a behavior change the probability of the behavior's recurrence. The American psychologist B. F. Skinner (1938) chose the term *operant* to describe the behavior of the organism. An operant behavior occurs spontaneously. According to Skinner, the consequences that follow such spontaneous behaviors determine whether the behavior will be repeated.

● **operant conditioning or instrumental conditioning** A form of associative learning in which the consequences of a behavior change the probability of the behavior's recurrence.

Imagine, for example, that you spontaneously decide to take a different route while driving to campus one day. You are more likely to repeat that route on another day if you have a pleasant experience—for instance, arriving at school faster or finding a new coffee place to try—than if you have a lousy experience such as getting stuck in traffic. In either case, the consequences of your spontaneous act influence whether that behavior happens again.

Recall that *contingency* is an important aspect of classical conditioning in which the occurrence of one stimulus can be predicted from the presence of another one. Contingency also plays a key role in operant conditioning. For example, when a rat pushes a lever (behavior) that delivers food, the delivery of food (consequence) is contingent on that behavior. This principle of contingency helps explain why passersby should never praise, pet, or feed a service dog while he is working (at least without asking first). Providing rewards during such times might interfere with the dog's training.

Thorndike's Law of Effect

Although Skinner emerged as the primary figure in operant conditioning, the experiments of E. L. Thorndike (1898) established the power of consequences in determining voluntary behavior. At about the same time that Pavlov was conducting classical conditioning experiments with salivating dogs, Thorndike, another American psychologist, was studying cats in puzzle boxes. Thorndike put a hungry cat inside a box and placed a piece of fish outside. To escape from the box and obtain the food, the cat had to learn to open the latch inside the box. At first the cat made a number of ineffective responses. It clawed or bit at the bars and thrust its paw through the openings. Eventually the cat accidentally stepped on the lever that released the door bolt. When the cat returned to the box, it went through the same random activity until it stepped on the lever once more. On subsequent trials, the cat made fewer and fewer random movements until finally it immediately stepped on the lever to open the door (Figure 4). Thorndike's resulting **law of effect** states that behaviors followed by pleasant outcomes are strengthened and that behaviors followed by unpleasant outcomes are weakened.

● **law of effect** Thorndike's law stating that behaviors followed by positive outcomes are strengthened and that behaviors followed by negative outcomes are weakened.

The law of effect is profoundly important because it presents the basic idea that the consequences of a behavior influence the likelihood of that behavior's recurrence. Quite simply, a behavior can be followed by something good or something bad, and the probability that a behavior will be repeated depends on these outcomes. As we now explore, Skinner's operant conditioning model expands on this basic idea.

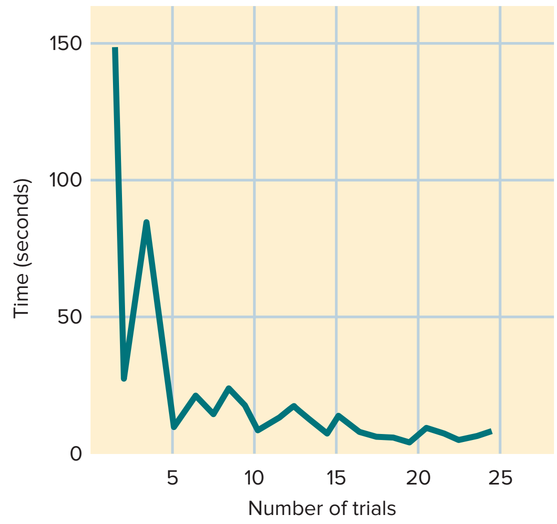


FIGURE 4 **Thorndike's Puzzle Box and the Law of Effect** (*left*) A box typical of the puzzle boxes Thorndike used in his experiments with cats to study the law of effect. Stepping on the lever released the door bolt; a weight attached to the door then pulled the door open and allowed the cat to escape. After accidentally pressing the lever as it tried to get to the food, the cat learned to press the lever when it wanted to escape the box. (*right*) One cat's learning curve over 24 separate trials. Notice that the cat escaped much more quickly after about five trials. It had learned the consequences of its behavior. Source: Thorndike (1898).

Skinner's Approach to Operant Conditioning

Skinner believed that the mechanisms of learning are the same for all species. This conviction led him to study animals in the hope that he could discover the components of learning with organisms simpler than humans, including pigeons. During World War II, Skinner trained pigeons to pilot missiles. Naval officials just could not accept pigeons guiding their missiles in a war, but Skinner congratulated himself on the degree of control he was able to exercise over the pigeons (Figure 5).

Skinner and other behaviorists made every effort to study organisms under precisely controlled conditions so that they could examine the connection between the operant behavior and the specific consequences in minute detail. In the 1930s, Skinner created an operant conditioning chamber, sometimes called a "Skinner box," to control experimental conditions (Figure 6). The Skinner box would allow an animal (such a rat) to be conditioned to push a bar to receive a reward with minimal interaction with a person.

A device in the box delivered food pellets into a tray at random. After a rat became accustomed to the box, Skinner installed a lever and observed the rat's behavior. As the hungry rat explored the box, it occasionally pressed the lever, and a food pellet was dispensed. Soon the rat learned that the consequences of pressing the lever were positive: It would be fed. Skinner achieved further control by soundproofing the box to ensure that the experimenter was the only influence on the organism. In many of the experiments, the responses were mechanically recorded, and the food (the consequence) was dispensed automatically. These precautions were aimed at preventing human error.

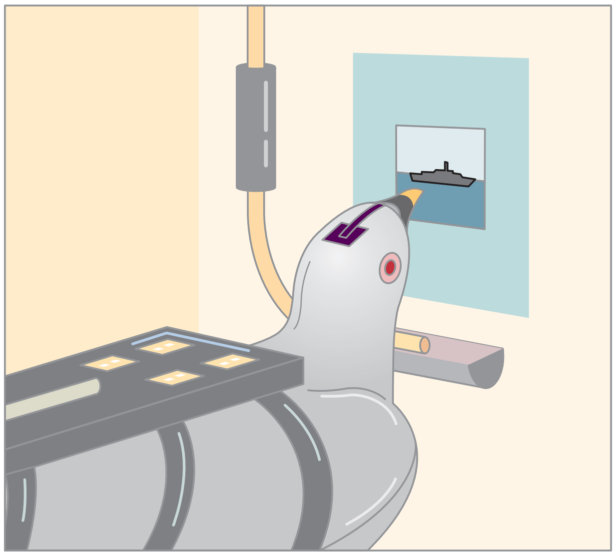


FIGURE 5 **Skinner's Pigeon-Guided Missile** Skinner wanted to help the military during World War II by using the tracking behavior of pigeons. A gold electrode covered the tip of the pigeons' beaks. Contact with the screen on which the image of the target was projected sent a signal informing the missile's control mechanism of the target's location. A few grains of food occasionally given to the pigeons maintained their tracking behavior.

Shaping

Imagine trying to teach even a really smart dog how to signal that her owner's blood-glucose level is low—or how to turn on the lights or do the laundry. These challenges might seem insurmountable, as it is unlikely that a dog will spontaneously perform any of these behaviors. You could wait a very long time for such feats to occur. Nevertheless, it *is* possible to train a dog or another animal to perform highly complex tasks through shaping.

Shaping refers to rewarding successive approximations of a desired behavior. For example, shaping can be used to train a rat to press a bar to obtain food. When a rat is first placed in a Skinner box, it rarely presses the bar. Thus, the experimenter may start off by giving the rat a food pellet if it is in the same half of the cage as the bar. Then the experimenter might reward the rat's behavior only when it is within 2 inches of the bar, then only when it touches the bar, and finally only when it presses the bar.

Returning to the service dog example, rather than waiting for the dog to spontaneously put the clothes in the washing machine, we might reward the dog for carrying the clothes to the laundry room and for bringing them closer and closer to the washing machine. Finally, we might reward the dog only when it gets the clothes inside the washer. Indeed, trainers use this type of shaping technique extensively in teaching animals to perform tricks. A dolphin that jumps through a hoop held high above the water has been trained to perform this behavior through shaping. Shaping is also used in interventions that help individuals who are coping with neurological disorders to walk (Thompson & others, 2018). To read about this fascinating work, see the Intersection.

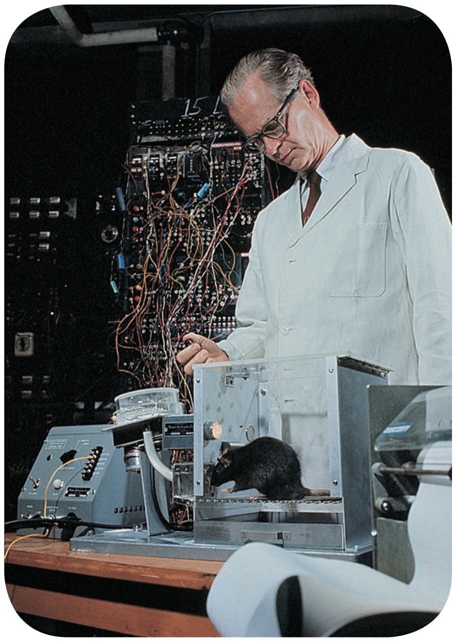


FIGURE 6 The Skinner Box
B. F. Skinner conducting an operant conditioning study in his behavioral laboratory. The rat being studied is in an operant conditioning chamber, sometimes referred to as a Skinner box. ©Nina Leen/Time & Life Pictures/Getty Images

Principles of Reinforcement

We noted earlier that a behavior can be followed by something pleasant or something unpleasant. When behaviors are followed by a desirable outcome, the behaviors are likely to be repeated. When behaviors are followed by an undesirable outcome, they are less likely to occur. Now we can put some labels on these different patterns.

Reinforcement is the process by which a stimulus or event (a *reinforcer*) following a particular behavior increases the probability that the behavior will happen again. These desirable (or rewarding) consequences of a behavior fall into two types, called *positive reinforcement* and *negative reinforcement.* Both of these types of consequences are experienced as pleasant, and both increase the frequency of a behavior.

Through shaping, animals can learn to do amazing things—even ride a wave, like these two canines.
©dutchmanphotography/iStock/Getty Images

POSITIVE AND NEGATIVE REINFORCEMENT

In **positive reinforcement** the frequency of a behavior increases because it is followed by a desirable stimulus. For example, if someone you meet smiles at you after you say, "Hello, how are you?" and you keep talking, the smile has reinforced your talking. The same principle of positive reinforcement is at work when you teach a dog to "shake hands" by giving it a piece of food when it lifts its paw.

In contrast, in **negative reinforcement** the frequency of a behavior increases because it is followed by *the removal* of something undesirable. For example, if your father nagged you to clean out the garage and kept nagging until you cleaned out the garage, your response (cleaning out the garage) removed the unpleasant stimulus (your dad's nagging). Taking an aspirin when you have a headache works the same way: A reduction of pain reinforces the act of taking an aspirin. Similarly, if your laptop is making an irritating buzzing sound, you might give it a good smack on the side, and if the buzzing stops, you are more likely to smack it again if the buzzing resumes. Ending the buzzing sound rewards the laptop-smacking.

Notice that both positive and negative reinforcement involve rewarding behavior—but they do so in different ways. Positive reinforcement means following a behavior with the addition of something pleasant, and negative reinforcement means following a behavior with the removal of something unpleasant. So, in this case "positive" and "negative" have nothing to do with "good" and "bad." Rather, they refer to processes in which something is given (positive reinforcement) or removed (negative reinforcement).

- **shaping** Rewarding successive approximations of a desired behavior.
- **reinforcement** The process by which a stimulus or event (a reinforcer) following a particular behavior increases the probability that the behavior will happen again.
- **positive reinforcement** The presentation of a stimulus following a given behavior in order to increase the frequency of that behavior.
- **negative reinforcement** The removal of a stimulus following a given behavior in order to increase the frequency of that behavior.

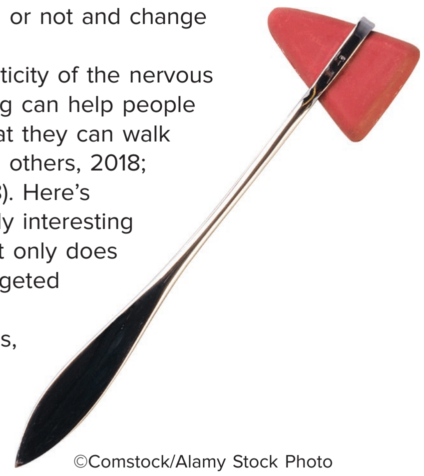
INTERSECTION

Psychology of Learning and Rehabilitation: Can Limbs Relearn Reflexes After Spinal Cord Injury?

Much of our capacity to walk depends on the use of reflexes deploying at precisely the right time, in precisely the right way. Many of these reflexes involve single neurons that activate muscles in our legs. A particularly problematic aspect of walking following a spinal cord injury is that reflexes become dysregulated. Individuals with incomplete spinal cord injury may find that their reflexes are too extreme or not strong enough (Eftekhar & others, 2018). As we have seen, operant conditioning is best suited to voluntary behaviors. Reflexes, of course, are not voluntary—they happen automatically. How can operant conditioning retrain these automatic reflexes? One way is to provide people with feedback about their reflexes so they can change their behavior accordingly (Eftekhar & others, 2018). Here is how it is done. While holding on to a handrail for safety, the person walks in place on a mat that has sensors tracking their gait. Electrodes placed on their legs convey information about their reflexes that are then shown on a monitor that the person watches. The patient can then see if their reflexes are optimal or not and change their behavior accordingly.

Can operant conditioning be used to shape even automatic behaviors?

Capitalizing on the plasticity of the nervous system, this type of training can help people retrain their reflexes so that they can walk (Al'bertin, 2018; Eftekhar & others, 2018; Mikolajczyk & others, 2018). Here's something that is especially interesting about this intervention: not only does the training benefit the targeted reflex, it also seems to generalize to other reflexes, providing broader benefits to a person's ability to move (Eftekhar & others, 2018). When a person can monitor even automatic behaviors, they can be brought into the realm of operant conditioning and respond to feedback—rewards and punishments—that shape that behavior. Of course, few things would be more rewarding than being able, at last, to take a walk in the park with family and friends.



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Whether it is positive or negative, reinforcement is about increasing a behavior (Eder, Krishna & Van Dessel, 2019). Be sure to review Figure 7, as it provides further examples to help you understand the distinction between positive and negative reinforcement. These processes can be tricky.

A special kind of response to negative reinforcement is avoidance learning. **Avoidance learning** occurs when the organism learns that by making a particular response, a negative stimulus can be avoided. For instance, a student who receives one bad grade might thereafter always study hard in order to avoid the negative outcome of bad grades in the future. Even when the bad grade is no longer present, the behavior pattern sticks. Avoidance learning is very powerful in the sense that the behavior is maintained even in the absence of any aversive stimulus. For example, animals that have been trained to avoid a negative stimulus, such as an electrical shock, by jumping into a safe area may thereafter gravitate toward the safe area, even when the shock is no longer presented.

- **avoidance learning** An organism's learning that it can altogether avoid a negative stimulus by making a particular response.

Experience with unavoidable negative stimuli can lead to a particular deficit in avoidance learning called learned helplessness. In **learned helplessness** the organism has learned that it has no control over negative outcomes. Learned helplessness was first identified by Martin Seligman and his colleagues (Altenor, Volpicelli, & Seligman, 1979; Hannum, Rosellini, & Seligman, 1976). Seligman and his associates found that dogs that were first exposed to inescapable shocks were later unable to learn to avoid those shocks, even when they could avoid them (Seligman & Maier, 1967). This inability to learn to escape was persistent: The dogs would suffer painful shocks hours, days, and even weeks later and never attempt to escape.

- **learned helplessness** An organism's learning through experience with negative stimuli that it has no control over negative outcomes.

Exposure to unavoidable negative circumstances may also set the stage for humans' inability to learn avoidance, such as with the experience of depression and despair (Landgraf & others, 2015; Reznik & others, 2017). Learned helplessness has aided psychologists in understanding a variety of perplexing issues, such as why some victims of domestic violence fail to escape their terrible situation and why some students respond to failure at school by no longer trying to succeed.

Positive Reinforcement

Behavior	Rewarding Stimulus Provided	Future Behavior
You turn in homework on time.	Teacher praises your performance.	You increasingly turn in homework on time.
You wax your skis.	The skis go faster.	You wax your skis the next time you go skiing.
You randomly press a button on the dashboard of a friend's car.	Great music begins to play.	You deliberately press the button again the next time you get into the car.

Negative Reinforcement

Behavior	Stimulus Removed	Future Behavior
You turn in homework on time.	Teacher stops criticizing late homework.	You increasingly turn in homework on time.
You wax your skis.	People stop zooming by you on the slopes.	You wax your skis the next time you go skiing.
You randomly press a button on the dashboard of a friend's car.	An annoying song shuts off.	You deliberately press the button again the next time the annoying song is on.

FIGURE 7 **Positive and Negative Reinforcement** Positive reinforcers involve adding something (generally something rewarding). Negative reinforcers involve taking away something (generally something aversive). Source: Eder, Krishna & Van Dessel (2019).

TYPES OF REINFORCERS

Psychologists classify positive reinforcers as primary or secondary based on whether the rewarding quality of the consequence is innate or learned. A **primary reinforcer** is innately satisfying; that is, a primary reinforcer does not require any learning on the organism's part to make it pleasurable. Food, water, and sexual satisfaction are primary reinforcers.

A **secondary reinforcer** acquires its positive value through an organism's experience; a secondary reinforcer is a learned or conditioned reinforcer. Secondary reinforcers can be linked to primary reinforcers through classical conditioning. For instance, if someone wanted to train a cat to do tricks, the person might first repeatedly pair the sound of a whistle with food. Once the cat associates the whistle with food, the whistle can be used in training.

We encounter hundreds of secondary reinforcers in our lives, such as getting an *A* on a test and a paycheck for a job. Although we might think of these as positive outcomes, they are not innately positive. We learn through experience that *A*'s and paychecks are good. Secondary reinforcers can be used in a system called a *token economy*. In a token economy behaviors are rewarded with tokens (such as poker chips or stars on a chart) that can be exchanged later for desired rewards (such as candy or money).

- **primary reinforcer** A reinforcer that is innately satisfying; a primary reinforcer does not require any learning on the organism's part to make it pleasurable.
- **secondary reinforcer** A reinforcer that acquires its positive value through an organism's experience; a secondary reinforcer is a learned or conditioned reinforcer.

GENERALIZATION, DISCRIMINATION, AND EXTINCTION

Not only are generalization, discrimination, and extinction important in classical conditioning, but they are also key principles in operant conditioning.

Generalization In operant conditioning, **generalization** means performing a reinforced behavior in a different situation. For example, in one study pigeons were reinforced for pecking at a disk of a particular color (Guttman & Kalish, 1956). To assess stimulus generalization, researchers presented the pigeons with disks of varying colors. As Figure 8 shows, the pigeons were most likely to peck at disks closest in color to the original. When a student who gets excellent grades in a calculus class by studying the course material every night starts to study psychology and history every night as well, generalization is at work.

- **generalization (in operant conditioning)** Performing a reinforced behavior in a different situation.

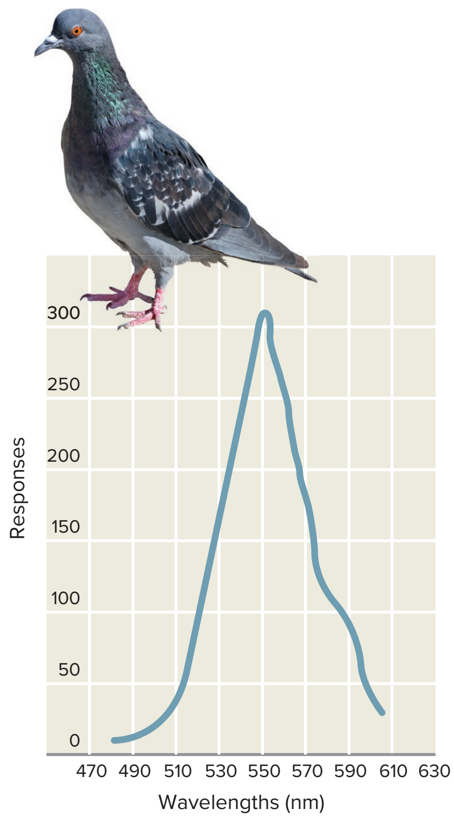


FIGURE 8 **Stimulus Generalization** In the experiment by Norman Guttman and Harry Kalish (1956), pigeons initially pecked at a disk of a particular color (in this graph, a color with a wavelength of 550 nm) after they had been reinforced for this wavelength. Subsequently, when the pigeons were presented with disks of colors with varying wavelengths, they were likelier to peck at those with a similar color to the original disk. Source: Guttman & Kalish (1956); ©s_oleg/Shutterstock

- **discrimination (in classical conditioning)** The process of learning to respond to certain stimuli and not others.

- **extinction (in operant conditioning)** Decreases in the frequency of a behavior when the behavior is no longer reinforced.

- **schedules of reinforcement** Specific patterns that determine when a behavior will be reinforced.

Discrimination In operant conditioning, **discrimination** means responding appropriately to stimuli that signal that a behavior will or will not be reinforced. For example, you go to a restaurant that has a "University Student Discount" sign in the front window, and you enthusiastically flash your student ID with the expectation of getting the reward of a reduced-price meal. Without the sign, showing your ID might get you only a puzzled look, not cheap food.

The principle of discrimination helps to explain how a service dog "knows" when she is working. Typically, the dog wears a training harness while on duty but not at other times. Thus, when a service dog is wearing her harness, it is important to treat her like the professional that she is. Similarly, an important aspect of the training of service dogs is the need for selective disobedience. Selective disobedience means that in addition to obeying commands from her human partner, the service dog must at times override such commands if the context provides cues that obedience is not the appropriate response. So, if a guide dog is standing at the street corner with her visually impaired owner, and the person commands her to move forward, the dog might refuse if she sees the "Don't Walk" sign flashing. Stimuli in the environment serve as cues, informing the organism if a particular reinforcement contingency is in effect.

Extinction In operant conditioning, **extinction** occurs when a behavior is no longer reinforced and decreases in frequency. If, for example, a soda machine that you frequently use starts "eating" your coins without dispensing soda, you quickly stop inserting more coins. Several weeks later, you might try to use the machine again, hoping that it has been fixed. Such behavior illustrates spontaneous recovery in operant conditioning (Bouton & Schepers, 2015).

CONTINUOUS REINFORCEMENT, PARTIAL REINFORCEMENT, AND SCHEDULES OF REINFORCEMENT

Most of the examples of reinforcement we have considered so far involve *continuous reinforcement,* in which a behavior is reinforced every time it occurs. When continuous reinforcement takes place, organisms learn rapidly. However, when reinforcement stops, extinction takes place quickly.

A variety of conditioning procedures have been developed that are particularly resistant to extinction. These involve *partial reinforcement,* in which a reinforcer follows a behavior only a portion of the time. Partial reinforcement characterizes most life experiences. For instance, a golfer does not win every tournament she enters; a chess whiz does not win every match she plays; a student does not get a pat on the back each time he solves a problem.

Schedules of reinforcement are specific patterns that determine when a behavior will be reinforced. There are four main schedules of partial reinforcement: fixed ratio, variable ratio, fixed interval, and variable interval. With respect to these, *ratio schedules* involve the number of behaviors that must be performed prior to reward, and *interval schedules* refer to the amount of time that must pass before a behavior is rewarded. In a fixed schedule, the number of behaviors or the amount of time is always the same. In a variable schedule, the required number of behaviors or the amount of time that must pass changes and is unpredictable from the perspective of the learner. Let's look concretely at how each of these schedules of reinforcement influences behavior.

A *fixed-ratio schedule* reinforces a behavior after a set number of behaviors. For example, a child might receive a piece of candy or an hour of video-game play not *every* time he practices his piano, but after five days of practicing at least an hour per day. A mail carrier must deliver mail to a fixed number of houses each day before he or she can head home. A factory might require a line worker to produce a certain number of items in order to get paid a particular amount. As you can imagine, fixed-ratio schedules are not very mysterious, especially to human learners.

Consider, for instance, if you were playing the slot machines in Las Vegas, and they were on a fixed-ratio schedule, providing a $5 win every 20th time you put money in the machine. It would not take long to figure out that if you watched someone else play the machine 18 or 19 times, not get any money back, and then walk away, you should step up, insert your coin, and get $5. Of course, if the reward schedule for a slot machine were that easy to figure out, casinos would not be so successful.

What makes gambling so tantalizing is the unpredictability of wins (and losses). Slot machines are on a *variable-ratio schedule,* a timetable in which behaviors are rewarded an average number of times but on an unpredictable basis. For example, a slot machine might pay off at *an average* of every 20th time, but the gambler does not know when this payoff will be. The slot machine might pay off twice in a row and then not again until after 58 coins have been inserted. This averages out to a reward for every 20 behavioral acts, but *when* the reward will be given is unpredictable.

Variable-ratio schedules produce high, steady rates of behavior that are more resistant to extinction than the other three schedules. Clearly, slot machines can make quite a profit. This is because not only are the rewards unpredictable, but they require behavior on the part of the person playing. One cannot simply wait around and then put in a coin after hours of not playing, hoping for a win. The machine requires that a certain *number* of behaviors occur; that is what makes it a *ratio* schedule.

In contrast to ratio schedules of reinforcement, *interval* reinforcement schedules are determined by the *time elapsed* since the last behavior was rewarded. A *fixed-interval schedule* reinforces the first appropriate behavior after a fixed amount of time has passed. If you take a class that has four scheduled exams, you might procrastinate most of the semester and cram just before each test. Fixed-interval schedules of reinforcement are also responsible for the fact that pets seem to be able to "tell time," eagerly sidling up to their food dish at 5 P.M. in anticipation of dinner. On a fixed-interval schedule, the rate of a behavior increases rapidly as the time approaches when the behavior likely will be reinforced. For example, suppose you are baking cookies, and when you put the cookie sheet into the oven, you set a timer. But before the timer goes off, you find yourself checking the cookies, over and over.

A *variable-interval schedule* is a timetable in which a behavior is reinforced after a variable amount of time has elapsed. Pop quizzes occur on a variable-interval schedule. Random drug testing follows a variable-interval schedule as well. So does fishing—you do not know if the fish will bite in the next minute, in a half hour, in an hour, or ever. Because it is difficult to predict when a reward will come, behavior is *slow and consistent* on a variable-interval schedule. This is why pop quizzes lead to more consistent levels of studying, compared with the cramming that might be seen with scheduled tests.

Let's take a closer look at the responses associated with each schedule of reinforcement in the Psychological Inquiry feature.

Slot machines are on a variable-ratio schedule of reinforcement.

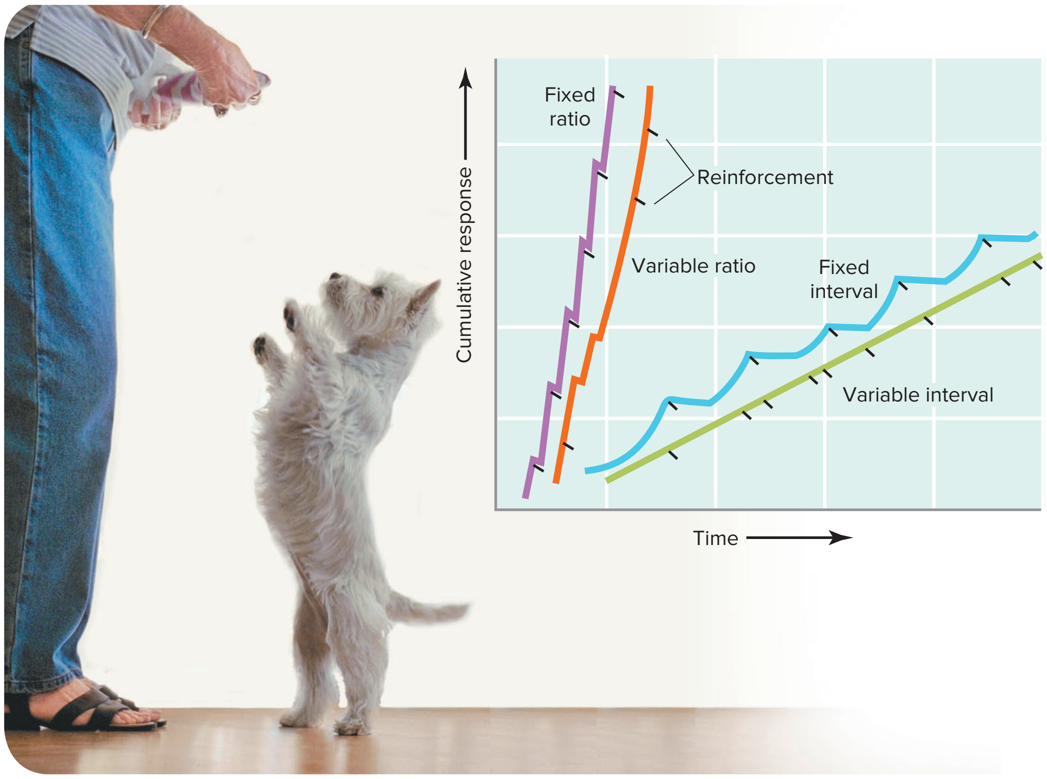
PUNISHMENT

We began this section by noting that behaviors can be followed by something good or something bad. So far, we have explored only the good things—reinforcers that are meant to increase behaviors. Sometimes, however, the goal is to decrease a behavior, and in such cases the behavior might be followed by something unpleasant. **Punishment** is a consequence that decreases the likelihood that a behavior will occur. For instance, a child plays with matches and gets burned when he lights one; the child consequently is less likely to play with matches in the future. As another example, a student interrupts the instructor, and the instructor scolds the student. This consequence—the teacher's verbal reprimand—makes the student less likely to interrupt in the future. In punishment, a response decreases because of its unpleasant consequences.

Just as the positive–negative distinction applies to reinforcement, it can also apply to punishment. As was the case for reinforcement, "positive" means adding something, and "negative" means taking something away. Thus, in **positive punishment** a behavior decreases when it is followed by the presentation of a stimulus, whereas in **negative punishment** a behavior decreases when a stimulus is removed. Examples of positive punishment include spanking a misbehaving child and scolding a spouse who forgot to call when she was running late at the office; the coach who makes his team run wind sprints after a lackadaisical practice is also using positive punishment. *Time-out* is a form of negative

- **punishment** A consequence that decreases the likelihood that a behavior will occur.
- **positive punishment** The presentation of a stimulus following a given behavior in order to decrease the frequency of that behavior.
- **negative punishment** The removal of a stimulus following a given behavior in order to decrease the frequency of that behavior.

psychological *inquiry*



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Schedules of Reinforcement and Different Patterns of Responding

This figure shows how the different schedules of reinforcement result in different rates of responding. The X or horizontal axis represents time. The Y or vertical axis represents the cumulative responses. That means that as the line goes up, the total number of responses are building and building. In the figure, each hash mark indicates the delivery of reinforcement. That is, each of those little ticks indicates that a reward is being given.

Look closely at the pattern of responses over time for each schedule of reinforcement. On the fixed-ratio schedule, notice the dropoff in responding after each response; on the variable-ratio schedule, note the high, steady rate of responding. On the fixed-interval schedule, notice the immediate dropoff in responding after reinforcement and the increase in responding just before reinforcement (resulting in a scalloped curve); and on the variable-interval schedule, note the slow, steady rate of responding.

1. Which schedule of reinforcement represents the “most bang for the buck”? That is, which one is associated with the most responses for the least amount of reward?
2. Which schedule of reinforcement is most similar to pop quizzes?
3. Which reinforcement schedule is most similar to regular tests on a course syllabus?
4. Which schedule of reinforcement would be best if you have very little time for training?
5. Which schedule of reinforcement do you think is most common in your own life? Why?

punishment in which a child is removed from a positive reinforcer, such as her toys. Getting grounded is also a form of negative punishment, as it involves taking a teenager away from the fun things in his life. Figure 9 compares positive reinforcement, negative reinforcement, positive punishment, and negative punishment.

TIMING, REINFORCEMENT, AND PUNISHMENTS

How does the timing of reinforcement and punishment influence behavior? And does it matter whether the reinforcement is small or large?

Immediate Versus Delayed Reinforcement As is the case in classical conditioning, in operant conditioning learning is more efficient when the interval between a behavior and its reinforcer is a few seconds rather than minutes or hours, especially in nonhuman animals. If a food reward is delayed for more than 30 seconds after a rat presses a bar, it is virtually ineffective as reinforcement. Humans have the ability to connect their behaviors to delayed reinforcers. We can, for instance, study hard knowing that a test is a few weeks away (as there is the reward of the grade we will earn).

Sometimes important life decisions involve whether to seek and enjoy a small, immediate reinforcer or to wait for a delayed but more highly valued reinforcer (Göllner &

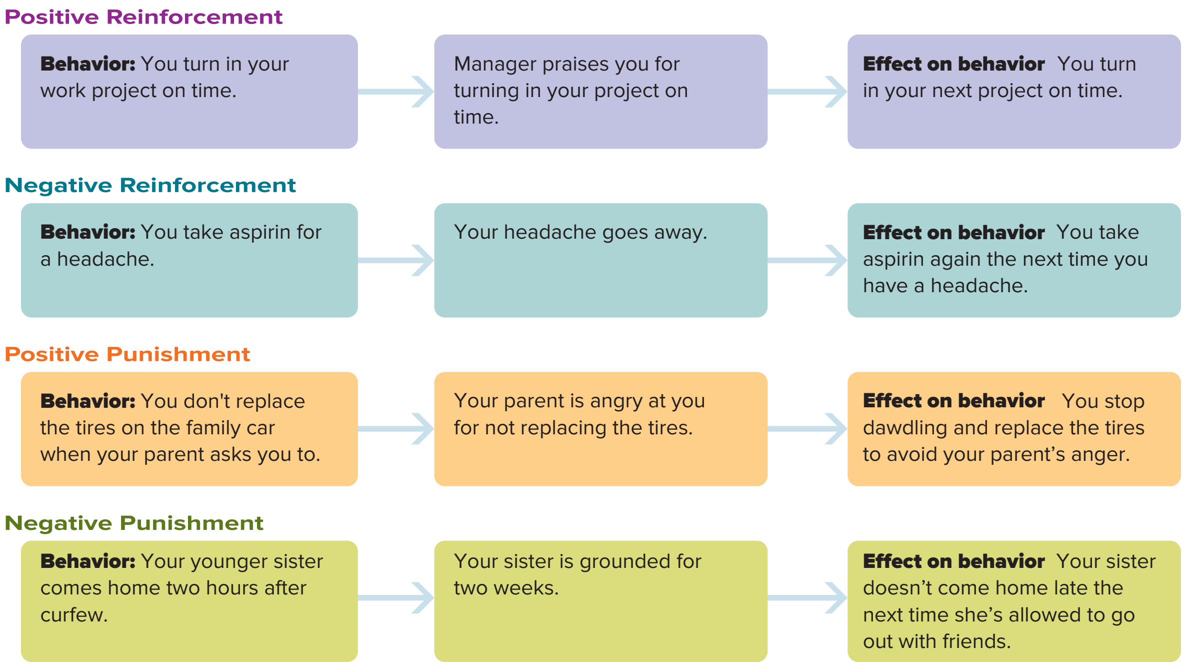

FIGURE 9 **Positive Reinforcement, Negative Reinforcement, Positive Punishment, and Negative Punishment** The fine distinctions here can sometimes be confusing. With respect to reinforcement, note that both types of reinforcement are intended to increase behavior, either by presenting a stimulus (in positive reinforcement) or by taking away a stimulus (in negative reinforcement). Punishment is meant to decrease a behavior either by presenting something (in positive punishment) or by taking away something (in negative punishment). The words *positive* and *negative* mean the same things in both cases.

others, 2018; Watson, & Milfont, 2017). For example, you might spend your money now on clothes, concert tickets, and the latest smartphone, or you might save your money and buy a car later. You might choose to enjoy yourself now in return for immediate small reinforcers, or you might opt to study hard in return for delayed stronger reinforcers like good grades, admission to grad school, and a better job.

Immediate Versus Delayed Punishment As with reinforcement, in most instances of research with lower animals, immediate punishment is more effective than delayed punishment in decreasing the occurrence of a behavior. However, also as with reinforcement, delayed punishment can have an effect on human behavior. Not studying at the beginning of a semester can lead to poor grades much later, and humans have the capacity to notice that this early behavior contributed to the negative outcome.

Immediate Versus Delayed Reinforcement and Punishment Many daily behaviors revolve around rewards and punishments, both immediate and delayed. We might put off going to the dentist to avoid a small punisher (such as the discomfort that comes with getting a cavity filled). However, this procrastination might contribute to greater pain later (such as the pain of having a tooth pulled). Sometimes life is about enduring a little pain now to avoid a lot of pain later.

How does receiving immediate small reinforcement versus delayed strong punishment affect human behavior? One reason that obesity is such a major health problem is that eating is a behavior with immediate positive consequences—food tastes great and quickly provides a pleasurable, satisfied feeling. Although the potential delayed consequences of overeating are negative (obesity and other possible health risks), the immediate consequences are difficult to override. When the delayed consequences of behavior are punishing and the immediate consequences are reinforcing, the immediate consequences usually win, even when the immediate consequences are minor reinforcers and the delayed consequences are major punishers.

Smoking and drinking follow a similar pattern. The immediate consequences of smoking are reinforcing for most smokers—the powerful combination of positive reinforcement

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(enhanced focus, energy boost) and negative reinforcement (tension relief, removal of craving). The primarily long-term effects of smoking are punishing and include shortness of breath, a chronic sore throat and/or coughing, chronic obstructive pulmonary disease (COPD), heart disease, and cancer. Likewise, the immediate pleasurable consequences of drinking override the delayed consequences of a hangover or even alcoholism and liver disease.

Now think about the following situations. Why are some of us so reluctant to take up a new sport, try a new dance step, run for office on campus or in local government, or do almost anything different? One reason is that learning new skills often involves minor punishing consequences, such as initially looking and feeling stupid, not knowing what to do, and having to put up with sarcastic comments from others. In these circumstances, reinforcing consequences are often delayed. For example, it may take a long time to become a good enough golfer or a good enough dancer to enjoy these activities, but persevering through the rough patches just might be worth it.

Applied Behavior Analysis

Some thinkers have criticized behavioral approaches for ignoring mental processes and focusing only on observable behavior. Nevertheless, these approaches do provide an optimistic perspective for individuals interested in changing their behaviors. That is, rather than concentrating on factors such as the type of person you are, behavioral approaches imply that you can modify even longstanding habits by changing the reward contingencies that maintain those habits.

One real-world application of operant conditioning principles to promote better functioning is applied behavior analysis. **Applied behavior analysis**, also called **behavior modification**, is the use of operant conditioning principles to change human behavior. In applied behavior analysis, the rewards and punishers that exist in a particular setting are carefully analyzed and manipulated to change behaviors. If we can figure out what rewards and punishers are controlling a person's behavior, we can change them—and eventually change the behavior itself.

● **applied behavior analysis or behavior modification** The use of operant conditioning principles to change human behavior.

A manager who rewards staff members with a casual-dress day or a half day off if they meet a particular work goal is employing applied behavior analysis. So are a therapist and a client when they establish clear consequences for the client's behavior in order to reinforce more adaptive actions and discourage less adaptive ones. A teacher who notices that a troublesome student seems to enjoy the attention he receives—even when that attention is scolding—might use applied behavior analysis by changing her responses to the child's behavior, ignoring it instead (an example of negative punishment). These examples show how attending to the consequences of behavior can be used to improve performance in settings such as the workplace or a classroom.

Applied behavior analysis has been effective in a wide range of situations. Practitioners have used it, for example, to treat individuals on the autism spectrum (Makrygianni & others, 2018), children and adolescents with psychological problems (Castillo & others, 2018), and residents of mental health facilities (Buchmeier & others, 2018); to instruct individuals in effective parenting (Pennefather & others, 2018); to enhance environmentally conscious behaviors such as recycling and properly disposing of garbage (Elba & Ivy, 2018); to get people to wear seatbelts (Kidd & others, 2018) and adhere to speed limits (Mullen, Maxwell, & Bédard, 2015); and to promote workplace safety (Gravina, King, & Austin, 2019; Yu & others, 2018).

test yourself

1. What is operant conditioning?
2. Define shaping and give two examples of it.
3. What is the difference between positive reinforcement and negative reinforcement? Between positive punishment and negative punishment?

4. OBSERVATIONAL LEARNING

Would it make sense to teach a 15-year-old girl how to drive with either classical conditioning or operant conditioning procedures? Driving a car is a voluntary behavior, so classical conditioning would not apply. In terms of operant conditioning, we could ask her to try to drive down the road and then reward her positive behaviors. Not many of us would want to be on the road, though, when she makes mistakes. Consider, as well, how many things human beings do that are arbitrary but important. We wave to say hello or goodbye, we eat certain foods for breakfast and not others. These conventions are learned through observational learning (Schoppmann, Schneider, & Seehagen, 2018).

If all of our learning were conducted in such a trial-and-error fashion, learning would be exceedingly tedious and at times hazardous. Although humans do learn through associative conditioning, we also learn in a different way: by observing others. Many complex behaviors are learned by watching competent models perform them (Bandura, 2011a). By observing other people, we can acquire knowledge, skills, rules, strategies, beliefs, and attitudes. The capacity to learn by observation eliminates trial-and-error learning, and often such learning takes less time than operant conditioning.

Observational learning, also called *imitation* or *modeling,* is learning that occurs when a person observes and imitates behavior. Perhaps the most famous example of observational learning is the Bobo doll study, conducted by Albert Bandura and his colleagues (Bandura, Ross, & Ross, 1961). In the study, children were randomly assigned to watch an adult either behave aggressively or nonaggressively toward an inflated doll. In the experimental condition, children saw the model hit an inflated Bobo doll with a mallet, kick it in the air, punch it, and throw it, all the while hollering aggressive phrases such as "Hit him!" "Punch him in the nose!" and "Pow!" In the control condition, the model played with Tinkertoys and ignored the Bobo doll. Children who watched the aggressive model were much more likely to engage in aggressive behavior when left alone with Bobo (Bandura, Ross, & Ross, 1961).

Bandura (1986) described four main processes that are involved in observational learning: attention, retention, motor reproduction, and reinforcement. The first process that must occur is *attention* (which we considered in the chapter "Sensation and Perception" due to its crucial role in perception). To reproduce a model's actions, you must attend to what the model is saying or doing. You might not hear what a friend says if music is blaring, and you might miss your instructor's analysis of a problem if you are admiring someone sitting in the next row. As a further example, imagine that you decide to take a class to improve your drawing skills. To succeed, you need to attend to the instructor's words and hand movements. Characteristics of the model can influence whether we pay attention to him or her. Warm, powerful, atypical people, for example, command more attention than do cold, weak, typical people.

Retention is the second process required for observational learning to occur. Retention means you must hold the information in memory. To reproduce a model's actions, you must encode the information and keep it in memory so that you can retrieve it. A simple verbal description, or a vivid image of what the model did, assists retention. (Memory is such an important cognitive process that we devote the chapter "Memory" exclusively to it.) In the example of taking a class to sharpen your drawing skills, you will need to remember what the instructor said and did in modeling good drawing skills.

Motor reproduction, a third element of observational learning, is the process of imitating the model's actions. People might pay attention to a model and encode what they have seen, but limitations in motor development might make it difficult for them to reproduce the model's action. A 13-year-old might see a professional basketball player do a reverse two-handed dunk but be unable to reproduce the pro's play. Similarly, in your drawing class, if you lack fine motor reproduction skills, you might be unable to follow the instructor's example.

Reinforcement is a final component of observational learning. In this case, the question is whether the model's behavior is followed by a consequence. Seeing a model attain a reward for an activity increases the chances that an observer will repeat the behavior—a process called *vicarious reinforcement*. On the other hand, seeing the model punished makes the observer less likely to repeat the behavior—a process called *vicarious punishment*. Unfortunately, vicarious reinforcement and vicarious punishment are often absent in, for example, media portrayals of violence and aggression.

Observational learning has been studied in a variety of contexts. Researchers have explored observational learning, for example, as a means by which gorillas learn from one another about motor skills (Byrne, Hobaiter, & Klailova, 2011). They have also studied it

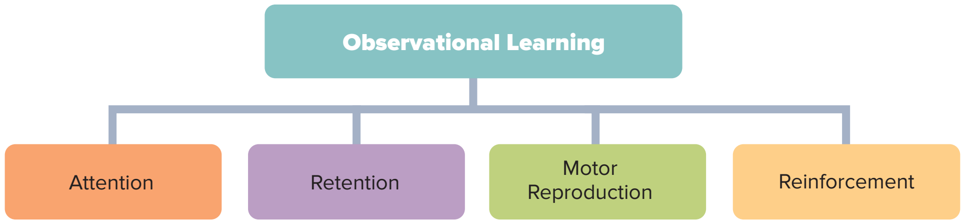


FIGURE 10 **Bandura's Model of Observational Learning** In terms of Bandura's model, if you are learning to ski, you need to attend to the instructor's words and demonstrations. You need to remember what the instructor did and said about how to avoid disasters. You also need the motor abilities to reproduce what the instructor has shown you. Praise from the instructor after you have completed a few moves on the slopes should improve your motivation to continue skiing.

as a process by which people learn whether stimuli are likely to be painful (Helsen & others, 2011) and as a tool individuals use to make economic decisions (Beshears & others, 2015).

Observational learning can be an important factor in the functioning of role models in inspiring people and changing their perceptions. Whether a model is similar to us can influence that model's effectiveness in modifying our behavior. The shortage of role models for women and minorities in science and engineering has often been suggested as a reason for the lack of women and minorities in these fields. After the election of Barack Obama as president of the United States, many commentators noted that for the first time, African American children could see concretely that they might also attain the nation's highest office someday. Figure 10 summarizes Bandura's model of observational learning.

test yourself

1. What are the four processes involved in observational learning?
2. What are two other names for observational learning?
3. What are vicarious reinforcement and vicarious punishment?

5. COGNITIVE FACTORS IN LEARNING

In learning about learning, we have looked at cognitive processes only as they apply in observational learning. Skinner's operant conditioning perspective and Pavlov's classical conditioning approach focus on the environment and observable behavior, not what is going on in the head of the learner. Many contemporary psychologists, including some behaviorists, recognize the importance of cognition and believe that learning involves more than environment–behavior connections. A good starting place for considering cognitive influences on learning is the work of E. C. Tolman.

Purposive Behavior

E. C. Tolman (1932) emphasized the *purposiveness* of behavior—the idea that much of behavior is goal-directed. Tolman believed that it is necessary to study entire behavioral sequences in order to understand why people engage in particular actions. For example, high school students whose goal is to attend a leading college or university study hard in their classes. If we focused only on their studying, we would miss the purpose of their behavior. The students do not always study hard because they have been reinforced for studying in the past. Rather, studying is a means to intermediate goals (learning, high grades) that in turn improve their likelihood of getting into the college or university of their choice. To understand human behavior, we sometimes need to place it in a larger context.

We can see Tolman's legacy today in the extensive interest in the role of goal setting in human behavior (Kaminer & others, 2018; Nelis & others, 2018). Researchers are especially curious about how people self-regulate and self-monitor their behavior to reach a goal (Reynolds & others, 2018).

EXPECTANCY LEARNING AND INFORMATION

In studying the purposiveness of behavior, Tolman went beyond the stimuli and responses of Pavlov and Skinner to focus on cognitive mechanisms. Tolman said that when classical conditioning and operant conditioning occur, the organism acquires certain expectations. In classical conditioning, the young boy fears the rabbit because he expects it will hurt him. In operant conditioning, a woman works hard all week because she expects a paycheck on Friday. Expectancies are acquired from people's experiences with their environment. Expectancies influence a variety of human experiences. We set the goals we do because we believe that we can reach them.

Expectancies also play a role in the placebo effect, described earlier. Many painkillers have been shown to be more effective in reducing pain if patients can see the intravenous injection sites (Price, Finniss, & Benedetti, 2008). If patients can observe that they are getting a drug, they can harness their own expectations for pain reduction.

Tolman (1932) emphasized that the information value of the conditioned stimulus is important as a signal or an expectation that an unconditioned stimulus will follow. Anticipating contemporary thinking, Tolman believed that the information that the CS provides is the key to understanding classical conditioning.

One contemporary view of classical conditioning describes an organism as an information seeker, using logical and perceptual relations among events, along with preconceptions, to form a representation of the world (Rescorla, 2003, 2004, 2005, 2006a, 2006b, 2006c, 2009).

A classic experiment conducted by Leon Kamin (1968) illustrates the importance of an organism's history and the information provided by a conditioned stimulus in classical conditioning. Kamin conditioned a rat by repeatedly pairing a tone (CS) and a shock (US) until the tone alone produced fear (CR). Then he continued to pair the tone with the shock, but he turned on a light (a second CS) each time the tone sounded. Even though he repeatedly paired the light (CS) and the shock (US), the rat showed no conditioning to the light (the light by itself produced no CR). Conditioning to the light was blocked, almost as if the rat had not paid attention. The rat apparently used the tone as a signal to predict that a shock would be coming; information about the light's pairing with the shock was redundant with the information already learned about the tone's pairing with the shock. In this experiment, conditioning was governed not by the contiguity of the CS and US but instead by the rat's history and the informational value of the stimuli it encountered. The rat already possessed a good signal for the shock; the additional CS was not useful (Mackintosh, 2018).

LATENT LEARNING

Experiments on latent learning provide other evidence to support the role of cognition in learning. **Latent learning** or **implicit learning** is unreinforced learning that is not immediately reflected in behavior.

● **latent learning or implicit learning** Unreinforced learning that is not immediately reflected in behavior.

In one study, researchers put two groups of hungry rats in a maze and required them to find their way from a starting point to an end point (Tolman & Honzik, 1930). The first group found food (a reinforcer) at the end point; the second group found nothing there. In the operant conditioning view, the first group should learn the maze better than the second group, which is exactly what happened. However, when the researchers subsequently took some of the rats from the nonreinforced group and gave them food at the end point of the maze, they quickly began to run the maze as effectively as the reinforced group. The nonreinforced rats apparently had learned a great deal about the maze as they roamed around and explored it. However, their learning was *latent,* stored cognitively in their memories but not yet expressed behaviorally. When these rats were given a good reason (reinforcement with food) to run the maze speedily, they called on their latent learning to help them reach the end of the maze more quickly.

Outside a laboratory, latent learning is evident when you walk around a new setting to get "the lay of the land." The first time you visited your college campus, you may have wandered about without a specific destination in mind. Exploring the environment made you better prepared when the time came to find that 8 A.M. class.

Insight Learning

Like Tolman, the German gestalt psychologist Wolfgang Köhler believed that cognitive factors play a significant role in learning. Köhler spent four months in the Canary Islands during World War I observing the behavior of apes. There he conducted two fascinating

FIGURE 11 **Insight Learning** Sultan, one of Köhler's brightest chimps, was faced with the problem of reaching a cluster of bananas overhead. He solved the problem by stacking boxes on top of one another to reach the bananas. Köhler called this type of problem solving "insight learning." (first) ©SuperStock; (second) ©SuperStock; (third) ©SuperStock

experiments—the stick problem and the box problem. Although these two experiments are basically the same, the solutions to the problems are different. In both situations, the ape discovers that it cannot reach an alluring piece of fruit, either because the fruit is too high or because it is outside of the ape's cage and beyond reach. To solve the stick problem, the ape has to insert a small stick inside a larger stick to reach the fruit. To master the box problem, the ape must stack several boxes to reach the fruit (Figure 11).

According to Köhler (1925), solving these problems does not involve trial and error or simple connections between stimuli and responses. Rather, when the ape realizes that its customary actions are not going to help it get the fruit, it often sits for a period of time and appears to ponder how to solve the problem. Then it quickly rises, as if it has had a sudden flash of insight, piles the boxes on top of one another, and gets the fruit. **Insight learning** is a form of problem solving in which the organism develops a sudden insight into or understanding of a problem's solution.

● **insight learning** A form of problem solving in which the organism develops a sudden insight into or understanding of a problem's solution.

The idea that insight learning is essentially different from learning through trial and error or through conditioning has always been controversial (Spence, 1938). Insight learning appears to entail both gradual and sudden processes, and understanding how these lead to problem solving continues to fascinate psychologists (Chu & MacGregor, 2011; Weisberg, 2015).

Research has documented that nonhuman primates are capable of remarkable learning that certainly appears to be insightful (Manrique, Völter, & Call, 2013). In one study, researchers observed orangutans trying to figure out a way to get a tempting peanut out of a clear plastic tube (Mendes, Hanus, & Call, 2007). The primates wandered about their enclosures, experimenting with various strategies. Typically, they paused for a moment before finally landing on a solution: Little by little they filled the tube with water that they transferred by mouth from their water dishes to the tube. Once the peanut floated to the top, the clever orangutans had their snack. Other research shows that chimps can solve the floating peanut task through observational learning (Tennie, Call, & Tomasello, 2010).

Insight learning requires that we think "outside the box," setting aside previous expectations and assumptions. One way to enhance insight learning and creativity in human beings is through multicultural experiences (Leung & others, 2008). Correlational studies have shown that time spent living abroad is associated with higher insight learning performance among MBA students (Maddux & Galinsky, 2009). Experimental studies have also demonstrated this effect. In one study, U.S. college students were randomly assigned to view one of two slide shows—one about Chinese and U.S. culture and the other about a control topic. Those who saw the multicultural slide show scored higher on measures of creativity and insight, and these changes persisted for a week (Leung & others, 2008).

Importantly, we can gain the benefits of multicultural exposure even without travel abroad or specific slide shows. One of the most dramatic changes in U.S. higher education is the increasing diversity of the student body. Might this growing diversity benefit students? Research suggests that it does. For instance, in a study of over 53,000 undergraduates at 124 colleges and universities, students' reported interactions with individuals from other racial and ethnic backgrounds predicted a variety of positive outcomes, including academic achievement, intellectual growth, and social competence (Hu & Kuh, 2003).

Many universities recognize that as U.S. society becomes more multiculturally diverse, students must be prepared to interact in a diverse community as they enter the job market. Participation in diversity courses in college is related to cognitive development (Bowman, 2010) and civic involvement (Gurin & others, 2002), with outcomes especially positive for non-Latino White students (Byrd, 2015; Hu & Kuh, 2003). Diverse groups provide broader knowledge and more varied perspectives than do homogeneous groups, to the positive benefit of all group members. As university communities become more diverse, they offer students an ever-greater opportunity to share and to benefit from those differences.

test yourself

1. What did Tolman mean by the purposiveness of behavior?
2. How do expectancies develop through classical and operant conditioning?
3. Define latent learning and insight learning and give an example of each.

6. BIOLOGICAL, CULTURAL, AND PSYCHOLOGICAL FACTORS IN LEARNING

Albert Einstein had many special talents. He combined enormous creativity with keen analytic ability to develop some of the twentieth century's most important insights into the nature of matter and the universe. Genes obviously endowed Einstein with extraordinary intellectual skills that enabled him to think and reason on a very high plane, but cultural factors also contributed to his genius. Einstein received an excellent, rigorous European education, and later in the United States he experienced the freedom and support believed to be important in creative exploration. Would Einstein have been able to develop his skills fully and to make such brilliant insights if he had grown up in a less advantageous environment? It is unlikely. Clearly, both biological *and* cultural factors contribute to learning.

Biological Constraints

Human beings cannot breathe under water, fish cannot ski, and cows cannot solve math problems. The structure of an organism's body permits certain kinds of learning and inhibits others. For example, chimpanzees cannot learn to speak human languages because they lack the necessary vocal equipment. In animals, various aspects of their physical makeup can influence what they can learn. Sometimes, species-typical behaviors (or instincts) can override even the best reinforcers, as we now consider.

INSTINCTIVE DRIFT

Keller and Marion Breland (1961), students of B. F. Skinner, used operant conditioning to train animals to perform at fairs and conventions and in television advertisements. They applied Skinner's techniques to teach pigs to cart large wooden nickels to a piggy bank and deposit them. They also trained raccoons to pick up a coin and drop it into a metal tray.

Although the pigs and raccoons, as well as chickens and other animals, performed most of the tasks well (raccoons became adept basketball players, for example—see Figure 12), some of the

FIGURE 12 **Instinctive Drift** This raccoon's skill in using its hands made it an excellent basketball player, but because of instinctive drift, the raccoon had a much more difficult time dropping coins into a tray. Source: Boston Public Library

animals began acting strangely. Instead of picking up the large wooden nickels and carrying them to the piggy bank, the pigs dropped the nickels on the ground, shoved them with their snouts, tossed them in the air, and then repeated these actions. The raccoons began to hold on to their coins rather than dropping them into the metal tray. When two coins were introduced, the raccoons rubbed them together in a miserly fashion. Somehow these behaviors overwhelmed the strength of the reinforcement. This example of biological influences on learning illustrates **instinctive drift**, the tendency of animals to revert to instinctive behavior that interferes with learning.

- **instinctive drift** The tendency of animals to revert to instinctive behavior that interferes with learning.

Why were the pigs and the raccoons misbehaving? The pigs were rooting, an instinct that is used to uncover edible roots. The raccoons were engaging in an instinctive food-washing response. Their instinctive drift interfered with learning.

PREPAREDNESS

Some animals learn readily in one situation but have difficulty learning in slightly different circumstances (Garcia & Koelling, 1966, 2009). The difficulty might result not from some aspect of the learning situation but from the organism's biological predisposition (Seligman, 1970). **Preparedness** is the species-specific biological predisposition to learn in certain ways but not others.

- **preparedness** The species-specific biological predisposition to learn in certain ways but not others.

Much evidence for preparedness comes from research on taste aversion (Garcia, 1989; Garcia & Koelling, 2009). Recall that taste aversion involves a single trial of learning the association between a particular taste and nausea. Rats that experience low levels of radiation after eating show a strong aversion to the food they were eating when the radiation made them ill. This aversion can last for as long as 32 days. Such long-term effects cannot be accounted for by classical conditioning, which would argue that a single pairing of the conditioned and unconditioned stimuli would not last that long (Garcia, Ervin, & Koelling, 1966). Taste aversion learning occurs in animals, including humans, that choose their food based on taste and smell. Other species are prepared to learn rapid associations between, for instance, colors of foods and illness.

Another example of preparedness comes from research on conditioning humans and monkeys to associate snakes with fear. Research has demonstrated that snakes have a natural power to evoke fear in many mammals (Åhs & others, 2018; Bertels & others, 2018). Many monkeys and humans fear snakes, and both monkeys and humans are very quick to learn the association between snakes and fear. In classical conditioning studies, when pictures of snakes (CS) are paired with electrical shocks (US), the snakes are likely to quickly and strongly evoke fear (CR). Interestingly, pairing pictures of, say, flowers (CS) with electrical shocks produces much weaker associations. More significantly, pictures of snakes can serve as conditioned stimuli for fearful responses, even when the pictures are presented so rapidly that they cannot be consciously perceived (Öhman & Mineka, 2001).

The link between snakes and fear has been demonstrated not only in classical conditioning paradigms. Monkeys that have been raised in the lab and that have never seen a snake rapidly learn to fear snakes, even entirely by observational learning. Lab monkeys that see a videotape of a monkey expressing fear toward a snake learn to be afraid of snakes faster than monkeys seeing the same fear video spliced so that the feared object is a rabbit, a flower, or a mushroom (Öhman & Mineka, 2003).

Such results seem to demonstrate preparedness among mammals to associate snakes with fear and aversive stimuli. They suggest that this association is related to the amygdala (the part of the limbic system that is related to emotion) and is difficult to modify. Preparedness for fear of snakes might have emerged out of the threat that reptiles likely posed to our evolutionary ancestors.

Cultural Influences

Traditionally, interest in the cultural context of human learning has been limited, partly because the organisms in those contexts typically were animals. The question arises, how might culture influence human learning? Most psychologists agree that the principles of classical conditioning, operant conditioning, and observational learning are universal and are powerful learning processes in every culture. However, culture can influence the *degree* to which these learning processes are used (Matsumoto & Juang, 2017). For example, Mexican American students may learn more through observational learning, while non-Latino White students may be more accustomed to learn through direct instruction (Martin & others, 2017).

In addition, culture can determine the *content* of learning (Mistry, Contreras, & Dutta, 2013; Zhang & Sternberg, 2013). We cannot learn about something we do not experience. The 4-year-old who grows up among the Bushmen of the Kalahari Desert is unlikely to learn about taking baths and eating with a knife and fork. Similarly, a child growing up in Chicago is unlikely to be skilled at tracking animals and finding water-bearing roots in the desert. Learning often requires practice, and certain behaviors are practiced more often in some cultures than in others. In Bali, many children are skilled dancers by the age of 6, whereas Norwegian children are much more likely to be good skiers and skaters by that age.

On the Indonesian island of Bali, young children learn traditional dances, whereas in Norway children commonly learn to ski early in life. As cultures vary, so does the content of learning.

(first) ©Paul Chesley/Stone/Getty Images; (second) ©Paul A. Souders/Getty Images

Psychological Constraints

Are there psychological constraints on learning? For animals, the answer is probably no. For humans, the answer may well be yes. This section opened with the claim that fish cannot ski. The truth of this statement is clear. Biological circumstances make it impossible. If we put biological considerations aside, we might ask ourselves about times in our lives when we feel like a fish trying to ski—when we feel that we just do not have what it takes to learn a skill or master a task (Talsma & others, 2018).

Some people believe that humans have particular learning styles that make it easier for them to learn in some ways but not others. For example, you may have heard that someone can be a visual learner (he or she learns by seeing), an aural learner (the person learns by listening), or a kinesthetic learner (the individual learns through hands-on experience). Although these labels may be popular, there is no evidence that teaching people in a way that matches their learning style leads to better learning (Pashler & others, 2008; Rohrer & Pashler, 2012). However, our beliefs about learning can affect whether we learn.

Carol Dweck (2006; Gunderson & others, 2018; Rattan & others, 2015) uses the term *mindset* to describe the way our beliefs about ability dictate what goals we set for ourselves, what we think we *can* learn, and ultimately what we *do* learn. Individuals have one of two mindsets: a *fixed mindset,* in which they believe that their qualities are carved in stone and cannot change; or a *growth mindset,* in which they believe their qualities can change and improve through their effort. These two mindsets have implications for the meaning of failure. From a fixed mindset, failure means lack of ability. From a growth mindset, however, failure tells the person what he or she still needs to learn. Your mindset influences whether you will be optimistic or pessimistic, what your goals will be, how hard you will strive to reach those goals, and how successful you are in college and after.

Dweck (2006) studied first-year pre-med majors taking their first chemistry class in college. Students with a growth mindset got higher grades than those with a fixed mindset. Even when they did not do well on a test, the growth-mindset students bounced back on the next test. Fixed-mindset students typically read and re-read the text and class notes or tried to memorize everything verbatim. The fixed-mindset students who did poorly on tests concluded that chemistry and maybe all pre-med courses were not for them. By contrast, growth-mindset students took charge of their motivation and learning, searching for themes and principles in the course and going over mistakes until they understood why they had made them. In Dweck's analysis, "They were studying to learn, not just ace the test. And, actually, this is why they got higher grades—not because they were smarter or had a better background in science" (Dweck, 2006, p. 61).

Dweck and her colleagues have continued to explore ways to improve students' motivation to achieve and succeed (Rattan & others, 2015). In one study, they assigned two groups of students to eight sessions of either (1) study skills instruction or (2) study skills instruction plus information about the importance of developing a growth mindset (called *incremental theory* in the research) (Blackwell, Trzesniewski, & Dweck, 2007). Exercises that increase growth-mindset emphasized that the brain is like a muscle that can change and grow as it is exercised and develops new connections. Students were informed that the more they challenged their brain to learn, the more their brain cells would grow. Prior to the intervention, both groups had a pattern of declining math scores. Following the intervention, the group that received the study skills instruction *plus* the growth-mindset emphasis reversed the downward trend and improved their math achievement.

Here are some effective strategies for developing a growth mindset (Dweck, 2006):

- *Understand that your intelligence and thinking skills are not fixed but can change.* Even if you are extremely bright, with effort you can increase your intelligence.
- *Become passionate about learning and stretch your mind in challenging situations.* It is easy to withdraw into a fixed mindset when the going gets tough. However, as you bump up against obstacles, keep growing, work harder, stay the course, and improve your strategies, you will become a more successful person.
- *Think about the growth mindsets of people you admire.* Possibly you have a hero, someone who has achieved something extraordinary. You may have thought his or her accomplishments came easily because the person is so talented. If you find out more about this person, though, you likely will discover that hard work and effort over a long period of time were responsible for his or her achievements.
- *Begin now.* If you have a fixed mindset, commit to changing now. Think about when, where, and how you will begin using your new growth mindset.

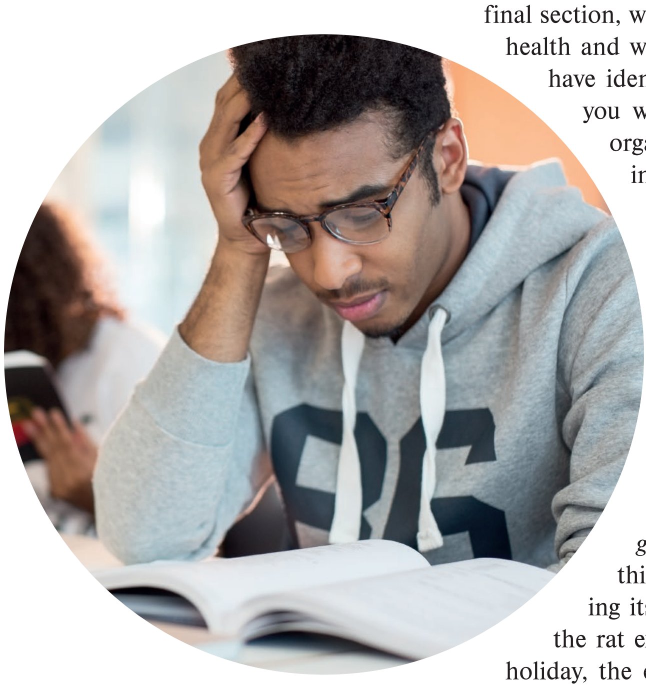
Dweck's work challenges us to consider the limits we place on our own learning. Our beliefs about ability profoundly influence what we try to learn. As any 7-year-old with a growth mindset would tell you, you never know what you can do until you try.

test yourself

1. What are two biological constraints on learning?
2. How does culture influence learning?
3. What is the difference between a fixed mindset and a growth mindset?

7. LEARNING AND HEALTH AND WELLNESS

In this chapter, we have examined the main psychological approaches to learning. In this final section, we consider specific ways that research on learning has shed light on human health and wellness. We examine in particular the factors that animal learning models have identified as playing an important role in the experience of stress—which, as you will recall from the chapter "Biological Foundations of Behavior", is the organism's response to a threat in the environment. A great deal of research in learning has relied primarily on models of animals, such as rats, to examine the principles that underlie human learning. Research on the stress response in rats provides useful insights into how we humans can deal with stress.



STRESS AND PREDICTABILITY

One very powerful aspect of potentially stressful experiences is their predictability. For a rat, predictability might depend on getting a warning buzzer before receiving a shock. Although the rat still experiences the shock, a buzzer-preceded shock causes less stress than a shock that is received with no warning (Abbott, Schoen, & Badia, 1984). Even having *good* experiences on a predictable schedule is less stressful than having good things happen at random times. For example, a rat might do very well receiving its daily chow at specific times during the day, but if the timing is random, the rat experiences stress. Similarly, when you receive a gift on your birthday or a holiday, the experience feels good. However, if someone surprises you with a present out of the blue, you might feel some stress as you wonder, "What is this person up to?"

Also relevant is classic research by Judith Rodin and her colleagues. In this study, nursing home residents showed better adjustment if they experienced a given number of visits at predictable times rather than the same number of visits at random times (Langer & Rodin, 1976).

STRESS AND CONTROL

Feeling in control may be a key to avoiding feelings of stress over difficulties (Carver & Scheier, 2013). Specifically, once you have experienced control over negative events, you may be "protected" from stress, even during trying times.

Returning to an animal model, suppose that a rat has been trained to avoid a shock by pressing a lever. Over time, even when the lever is no longer related to the shock, the rat presses it during the shock—and experiences less stress. We might imagine the rat thinking, "Gee, it would be worse if I weren't pressing this lever!" Researchers have also found links between having control and experiencing stress in humans. For example, as mentioned above with the nursing home study (Langer & Rodin, 1976), residents are more likely to thrive if they receive visits at times they personally choose. In addition, simply having a plant to take care of is associated with living longer for nursing home residents.

A lack of control over aversive stimuli can be particularly stressful. For example, individuals exposed to uncontrollable loud blasts of noise show lower immune system function (Sieber & others, 1992). One result of exposure to uncontrollable negative events is *learned helplessness,* which we examined earlier in this chapter. In learned helplessness, the organism has learned through experience that outcomes are not controllable. As a result, the organism stops trying to exert control.

Research has shown that, to break the lock of learned helplessness, dogs and rats have to be forcibly moved to escape an aversive shock (Seligman, Rosellini, & Kozak, 1975). From such animal studies, we can appreciate how difficult it may be for individuals who find themselves in situations in which they have little control—for example, women who are victims of domestic violence (Walker, 2009)—to take action. We can also appreciate the helplessness sometimes experienced by students with learning difficulties who withdraw from their coursework because they feel unable to influence outcomes in school (Gwernan-Jones & Burden, 2010).

STRESS AND IMPROVEMENT

Imagine that you have two rats, both of which are receiving mild electrical shocks. One of them, Jerry, receives 50 shocks every hour, and the other, Chuck-E, receives 10 shocks every hour. The next day both rats are switched to 25 shocks every hour. Which one is more stressed out at the end of the second day? The answer is that even though Jerry has experienced more shocks in general, Chuck-E is more likely to show the wear and tear of stress. In Jerry's world, even with 25 shocks an hour, *things are better*. The perception of improvement, even in a situation that is objectively worse than another, is related to lower stress (Sapolsky, 2004).

OUTLETS FOR FRUSTRATION

When things are not going well for us, it often feels good to find an outlet, such as going for a run or, perhaps even better, taking a kickboxing class. Likewise, for a rat, having an outlet for life's frustrations is related to lower stress symptoms. Rats that have a wooden post to gnaw on or even a furry little friend to complain to are less stressed out in response to negative circumstances.

Although studies using rats and dogs may seem far afield of our everyday experiences, researchers' observations provide important clues for avoiding stress. When we cultivate predictable environments and take control of circumstances, stress decreases. Further, when we can see improvement, even in difficult times, stress is likely to diminish. Finally, when we have an outlet for our frustrations in life—whether it is physical exercise, writing, or art—we can relieve our stress. When it comes to stress, humans have a lot to learn from rats.

test yourself

1. Based on research involving animal models, what are four ways in which human beings can reduce stress?
2. What is the main effect of learned helplessness on an organism?
3. Why do individuals who are experiencing domestic violence often have difficulty overcoming their troubles?

SUMMARY

1. TYPES OF LEARNING

Learning is a systematic, relatively permanent change in behavior that occurs through experience. Associative learning involves learning by making a connection between two events. Observational learning is learning by watching what other people do. Conditioning is the process by which associative learning occurs. In classical conditioning, organisms learn the association between two stimuli. In operant conditioning, they learn the association between behavior and a consequence.

2. CLASSICAL CONDITIONING

Classical conditioning occurs when a neutral stimulus becomes associated with a meaningful stimulus and comes to elicit a similar response. Pavlov discovered that an organism learns the association between an unconditioned stimulus (US) and a conditioned stimulus (CS). The US automatically produces the unconditioned response (UR). After conditioning (CS–US pairing), the CS elicits the conditioned response (CR) by itself. Acquisition in classical conditioning is the initial linking of stimuli and responses, which involves a neutral stimulus being associated with the US so that the CS comes to elicit the CR. Two important aspects of acquisition are contiguity and contingency.

Generalization in classical conditioning is the tendency of a new stimulus that is similar to the original conditioned stimulus to elicit a response that is similar to the conditioned response. Discrimination is the process of learning to respond to certain stimuli and not to others. Extinction is the weakening of the CR in the absence of the US. Spontaneous recovery is the recurrence of a CR after a time delay without further conditioning. Renewal is the occurrence of the CR (even after extinction) when the CS is presented in a novel environment.

In humans, classical conditioning has been applied to eliminating fears, treating addiction, understanding taste aversion, and explaining different experiences such as pleasant emotions and drug overdose.

3. OPERANT CONDITIONING

Operant conditioning is a form of learning in which the consequences of behavior produce changes in the probability of the behavior's occurrence. Skinner described the behavior of the organism as operant: The behavior operates on the environment, and the environment in turn operates on the organism. Whereas classical conditioning involves respondent behavior, operant conditioning involves operant behavior. In most instances, operant conditioning is better at explaining voluntary behavior than is classical conditioning.

Thorndike's law of effect states that behaviors followed by pleasant outcomes are strengthened, whereas behaviors followed by unpleasant outcomes are weakened. Skinner built on this idea to develop the notion of operant conditioning.

Shaping is the process of rewarding approximations of desired behavior in order to shorten the learning process. Principles of reinforcement include the distinction between positive reinforcement (the frequency of a behavior increases because it is followed by a rewarding stimulus) and negative reinforcement (the frequency of behavior increases because it is followed by the removal of an aversive, or unpleasant, stimulus). Positive reinforcement can be classified as primary reinforcement (using reinforcers that are innately satisfying) and secondary reinforcement (using reinforcers that acquire positive value through experience).

Reinforcement can also be continuous (a behavior is reinforced every time) or partial (a behavior is reinforced only a portion of the time). Schedules of reinforcement—fixed ratio, variable ratio, fixed interval, and variable interval—determine when a behavior will be reinforced.

Operant, or instrumental, conditioning involves generalization (giving the same response to similar stimuli), discrimination (responding to stimuli that signal that a behavior will or will not be reinforced), and extinction (a decreasing tendency to perform a previously reinforced behavior when reinforcement is stopped).

Punishment is a consequence that decreases the likelihood that a behavior will occur. In positive punishment, a behavior decreases when it is followed by a (typically unpleasant) stimulus. In negative punishment, a behavior decreases when a positive stimulus is removed from it.

Applied behavior analysis, or behavior modification, involves the application of operant conditioning principles to a variety of real-life behaviors.

4. OBSERVATIONAL LEARNING

Observational learning occurs when a person observes and imitates someone else's behavior. Bandura identified four main processes in observational learning: attention (paying heed to what someone is saying or doing), retention (encoding that information and keeping it in memory so that you can retrieve it), motor reproduction (imitating the actions of the person being observed), and reinforcement (seeing the person attain a reward for the activity).

5. COGNITIVE FACTORS IN LEARNING

Tolman emphasized the purposiveness of behavior. His belief was that much of behavior is goal-directed. In studying purposiveness, Tolman went beyond stimuli and responses to discuss cognitive mechanisms; he believed that expectancies, acquired through experiences with the environment, are an important cognitive mechanism in learning.

Latent learning is unreinforced learning that is not immediately reflected in behavior. Latent learning may occur when a rat or a person roams a particular location and shows knowledge of the area when that knowledge is rewarded.

Köhler developed the concept of insight learning, a form of problem solving in which the organism develops a sudden insight into or understanding of a problem's solution.

6. BIOLOGICAL, CULTURAL, AND PSYCHOLOGICAL FACTORS IN LEARNING

Biology restricts what an organism can learn from experience. These constraints include instinctive drift (the tendency of animals to revert to instinctive behavior that interferes with learned behavior), preparedness (the species-specific biological predisposition to learn in certain ways but not in others), and taste aversion (the biological predisposition to avoid foods that have caused sickness in the past).

Although most psychologists agree that the principles of classical conditioning, operant conditioning, and observational learning are universal, cultural customs can influence the degree to which these learning processes are used. Culture also often determines the content of learning.

In addition, what we learn is determined in part by what we believe we can learn. Dweck emphasizes that individuals benefit enormously from having a growth mindset rather than a fixed mindset.

7. LEARNING AND HEALTH AND WELLNESS

Research using rats and other animals has demonstrated four important variables involved in the human stress response: predictability, perceived control, perceptions of improvement, and outlets for frustration.

key *terms*

acquisition
applied behavior analysis or behavior modification
associative learning
aversive conditioning
avoidance learning
behaviorism
classical conditioning
conditioned response (CR)
conditioned stimulus (CS)
counterconditioning
discrimination (in classical conditioning)
discrimination (in operant conditioning)
extinction (in classical conditioning)
extinction (in operant conditioning)
generalization (in classical conditioning)
generalization (in operant conditioning)
habituation
insight learning
instinctive drift
latent learning or implicit learning
law of effect
learned helplessness
learning
negative punishment
negative reinforcement
observational learning
operant conditioning or instrumental conditioning
positive punishment
positive reinforcement
primary reinforcer
punishment
preparedness
reinforcement
renewal
schedules of reinforcement
secondary reinforcer
shaping
spontaneous recovery
unconditioned response (UR)
unconditioned stimulus (US)

apply your *knowledge*

1. Enlist some of your classmates to play this mind game on your professor. Every time your instructor moves to the right side of the room during lecture, be more attentive, smile, and nod. Start out by shaping—every time he or she moves even a little to the right, give a smile or nod. See how far you can get the instructor to go using this simple reward. In one introductory psychology class, students got their professor to move all the way to the right wall of the classroom, where she leaned, completely clueless.

2. The next time you are alone with a friend, try your best to use shaping and the principles of operant conditioning to get the person to touch the tip of his or her nose. Can you do it?

3. Demonstrate Pavlov's work with your friends. First buy some lemons and slice them. Then gather a group of friends to watch something on TV together, maybe the Academy Awards or the Super Bowl. Pick a conditioned stimulus that you know will come up a lot on the show—for example, someone saying "thank you" during the Oscars or a soft drink or beer ad during the Super Bowl. For the first half hour, everyone has to suck on a lemon slice (the US) when the CS is presented. After the first half hour, take the lemons away. Have everyone report on their salivation levels (the CR) whenever the CS is presented later in the show. What happens?

4. Positive reinforcement and negative reinforcement can be difficult concepts to grasp. The real-world examples and accompanying practice exercises on the following website should help to clarify the distinction:

   http://psych.athabascau.ca/html/prtut/reinpair.htm

5. Imagine that you are about to begin an internship in an organization where you would like to have a permanent position someday. Use the processes of observational learning to describe your strategy for making the most of your internship.